Title: the effectiveness of a multimedia exercise programme among postpartum women with lumbopelvic pain in Taiwan

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THE EFFECTIVENESS OF A MULTIMEDIA EXERCISE PROGRAMME AMONG POSTPARTUM WOMEN WITH LUMBOPELVIC PAIN IN TAIWAN

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by

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A thesis submitted to the University of Bedfordshire in partial fulfilment of the requirements for the degree of Doctor of Philosophy

December, 2018

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I, Pei-Ching Tseng declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

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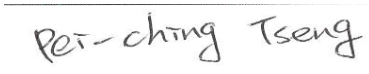
Name of candidate: Pei-Ching Tseng Signature: 

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THE EFFECTIVENESS OF A MULTIMEDIA EXERCISE PROGRAMME AMONG

POSTPARTUM WOMEN WITH LUMBOPELVIC PAIN IN TAIWAN

P.C. TSENG

ABSTRACT

Background: A substantial number of women are affected by Lumbo Pelvic Pain (LPP) following pregnancy and childbirth. Physical exercise is indicated as a beneficial method to relieve LPP, but individual studies appear to suggest mixed findings relating to its effectiveness and do not provide sufficient evidence on their own to warrant definite conclusions about effectiveness. Studies examining the effectiveness of different modes of exercise instruction for postpartum women for LPP are sparse.

Aim: The aim of the study was to synthesise the evidence relating to the effectiveness of various exercise programmes on LPP and to assess the effectiveness and acceptability (uptake, adherence and completion rate) of an exercise programme delivered using Digital Versatile Disc (DVD), the Internet or leaflet (usual care), on LPP among postnatal women in Taiwan.

Methods: Phase 1: a systemic review of randomised controlled trials (RCTs) published between January 1990 and July 2014 was conducted by searching several databases, electronic libraries and grey literature. Phase 2: a primary study (pragmatic randomised controlled trial) design with two intervention groups and a control group with outcomes measured at discharge period (as baseline), six weeks and four months follow-ups. The outcomes of LPP, physical endurance, exercise uptake, adherence and completion rate across the three modes of delivery were assessed.

Findings: Phase 1 of the systematic review established that four RCTs met the selection criteria, involving 251 postnatal women. The trials included physical exercise programmes with varying components, differing modes of delivery, follow up times and outcome measures. Intervention in one trial, involving physical therapy with specific stabilising exercises, proved to be effective in reducing LPP intensity. An improvement in gluteal pain on the right side was reported in one trial and a significant difference in pain frequency in another.

Phase 2 PRCT study: Of 213 pregnant women with LPP recruited, 158 took part in the trial. The women reported significant reduction in LPP in the Internet-based group (pain in the past week, $p< 0.005$) at six weeks postpartum. Physical endurance of DRI outcome revealed a significant result in the DVD-based group at six weeks postpartum (standing bent over a sink ($p<0.008$)). Acceptability of exercise interms of completion rate, adherence and uptake was not significantly different between the three groups; even though the Internet-based group undertook exercise more frequently.

Conclusion: The systematic review revealed that only a few RCTs evaluated the effectiveness of exercise on LPP, and there is variability in the components of the exercise programmes, modes of delivery, follow up times and outcome measures. The trial determined that the Internet-based postpartum exercise programme was effective in reducing pain and the DVD-based exercise programme in improving disability status, in women with LPP post-pregnancy. However, the Internet-based instruction increased adherence to exercise in postpartum women. The findings have implications for developing appropriate intervention programmes.

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List of abbreviations

ASLR	Active Straight Leg Raising
BMI	Body Mass Index
DRI	Disability Rating Index
DVD	Digital Versatile Disc
LPP	Lumbo Pelvic Pain
NHP	Nottingham Health Profile
PEDro	Physiotherapy Evidence Database
PICOS	Population, Intervention, Comparator, Outcome, Study design
PPPP	Posterior Pelvic Pain Provocation
PRCT	Pragmatic Randomised Controlled Trial
RCT	Randomised Controlled Trial
VAS	Visual Analogue Scale

Overview of chapter

There are 8 chapters in total in the thesis. Chapter 1 outlines the background of the research, the rationale, the aim and the objectives of the study.

Chapter 2 comprises the literature review. It discusses the definition, location, aetiology, diagnosis and treatment. The chapter also discusses the benefits of exercise, and the barriers to exercise programmes in general, women's attitude and practice of exercise, besides the reasons for lack of exercise uptake despite all the benefits. The medium of exercise interventions in health and care including videotape, DVD, the Internet are also presented in this chapter. The last part of this chapter discusses the development in addition to the application of theoretical model as multimedia learning theory in practice.

Chapter 3 and 4 focuses on the research design, including the systematic review and pragmatic randomised controlled trial (PRCT) designs used in this study. The PICOS model used for the review, inclusion and exclusion criteria, search strategy and selection procedure are presented in detail. Chapter 4 also explains the PRCT, the key elements of the design, study site, participant recruitment and inclusion criteria, intervention measurements, assessment tools, sample size and the analytical methodologies applied.

Chapter 5 and 6 discuss the systematic review and PRCT study findings. The review findings include search outcomes, results of the methodological quality assessment and components of interventions and outcomes synthesised. Chapter 6 discusses PRCT study findings include a comparison of the baseline and follow up results in LPP, physical endurance and core muscles, plus, the exercise adherence outcomes.

Finally, Chapter 7 discusses the findings of the research and compares it with the previous findings and theoretical framework. Chapter 8 presents the summary of the research findings and discusses the implications for clinical practice and future research. The strengths and limitations of the research are also included in this chapter.

Chapter 1

Introduction

1.1 Background to the study

Becoming a mother is a crucial process for women because it can positively influence their overall health and wellbeing. The experience of women from pregnancy to the postnatal period is a time of major psychological and social change for women as they change their roles as mothers. Pregnancy leads to significant physiological changes in the body, including increased cardiorespiratory capacity, musculoskeletal, hormonal and several other physiological adaptations. The musculoskeletal changes obviously appear in the enlarging gravid uterus moving the body's centre of gravity forward, increasing any tendency for lumbar lordosis. The enlarging uterus and lumbar lordosis can influence the stability of the pelvic girdle and cause pain in the low back area (Chang et al., 2014). Posture changes during pregnancy and postpartum may cause lower back pain.

Lumbo pelvic pain (LPP) is defined as pain in the region of the lower back and/or anterior and/or posterior region of the pelvis (Olsson et al., 2012a). According to Pierce et al. (2012), low back pain refers to the LPP experienced at the 5th lumbar vertebra and above, and pelvic girdle pain in the range between the 5th lumbar vertebra and the iliac crests, which include anterior, posterior and/or lateral views. LPP covering the 5th lumbar vertebra and above in the area between the level of L5 and the iliac crests, as well as below the iliac crests, are named as combined low back pain and pelvic girdle pain.

LPP may be concentrated in the posterior pelvic area and it may shift localisation from the lumbar to sacral and can also be accompanied by pain in the pubic symphysis. More than half of pregnant women with LPP reported that the standing position aggravated their pain, followed by the sitting position, bending position, lying position and walking position (Wang et al., 2004; Al-Sayegh et al., 2012). Most of the pain distribution was described in the low back area. Women experienced the pain sometimes as radiating pain, primarily to the knees or to the buttocks. It is generally made worse by prolonged standing and/or sitting and when turning in bed (Ansari et al., 2010). The pain is often worse in the evenings and at nights, and the degree of evening pain is often related to the amount of activity during the day (Eggen et al., 2012; Stafne et al., 2012).

When diagnoses of LPP was undertaken, clinical tests were conducted, and a detailed history was taken from the patient. Clinical tests consisted of the active straight leg raise (ASLR) test, posterior pelvic pain provocation (PPPP) test, sacroiliac joint pain provocation test and lumbar spine pain provocation test (Albert et al., 2000; Vleeming et al., 2008; Mens et al., 2012a). The detailed history comprised the location of pain, onset, radiation (whether the pain radiates to the legs), exacerbating and relieving factors (whether the pain is worse after rest or movement), associated symptoms and severity (Walker, 2012). Based on Sabino and Grauer's research (2008), due to the concern about damaging the foetus during pregnancy, very few tests are available as tools for diagnosing the reasons for LPP. Instead, the history is recorded in detail and symptoms are usually used as evidence for diagnosis (Sabino and Grauer, 2008). In general, the evaluation of LPP is typically based on self-administered questionnaires or interviews, and occasionally assessed by clinical evaluation.

The prevalence of LPP during pregnancy ranges between 26.5% and 91% in different studies (Kumle et al., 2004; Mogren, 2005; Ayanniyi et al., 2006; Skaggs et al., 2007; Ansari et al., 2010; Chang et al., 2011; Al-Sayegh et al., 2012; Gjestland et al., 2012; Robinson et al., 2014). Kumle et al. (2004), used questionnaires to understand pregnancy-related pelvic pain for 2078 Norwegian women. The result was that 26.5% of women had pelvic pain during the first pregnancy. Mogren (2005), established that 72% of pregnant women had experienced pain from the lumbar spine or pelvis for more than 1 week. Ayanniyi et al. (2006), investigated 2187 women in relation to the prevalence and pattern of back pain in pregnancy. Of the women examined, 1919 pregnant women (52.5%) had experienced back pain. Most of the areas that experienced pain were in the low back and posterior pelvic (66.4% and 24% respectively). Skaggs et al. (2007), reported that 67% of women complained of musculoskeletal pain during pregnancy, and more than half of the women had pain in the low back area.

A cross-sectional study investigated a population of Iranian women with low back pain during pregnancy. It found that 57.3% of women had low back pain during pregnancy (Ansari et al., 2010). Gjestland et al. (2012), reported the prevalence of LPP during pregnancy at 32 weeks, with 52.1% of women having low back pain and 51.7% pelvic girdle pain. Robinson et al. (2014), used self-reporting questionnaires to determine the prevalence of pelvic girdle pain from gestation week 30 to one year postpartum. Results showed that 63% of women had pelvic girdle pain at 30 weeks of gestation. A high prevalence of LPP during pregnancy was reported by Al-Sayegh's study. This study found that 91% of women reported experiencing LPP in their current pregnancies (Al-Sayegh et al., 2012).

Although, LPP develops in pregnancy (Olsson et al., 2012a), women continue to experience the pain with varying intensity and duration in the postpartum period (To and Wong, 2003;

Thorell and Kristiansson, 2012). The prevalence of postnatal back pain described in the literature varies considerably between women due to different follow-up times, methods of measurement and definitions of persistent back pain in the different studies. For instance, Nilsson-Wikmar et al. (2003), used examinations and questionnaires to investigate six to ten months postpartum women with back pain. Subjects took ten pain provocation tests (symphysis pubis pressure test, ligament stress test/posterior shear test, iliac gapping/ distraction test, etc.) to diagnose women into four different back pain patterns. 119 postpartum women were examined. 27% of the women were found to have posterior pelvic pain, 18% lumbar pain, 39% of women had combined pain of the posterior pelvic/sacroiliac joints and in the lumbar spine, whilst 16% of participants exhibited no pain in the back.

The authors measured pain intensity and activity limitations via a visual analogue scale (VAS) and disability rating index (DRI) respectively. Results for pain intensity showed no statistically significant differences between the four groups, whereas the activity limitations results found significantly different DRI scores between the three groups with pain and one group without pain (Nilsson-Wikmar et al., 2003). A randomised controlled trial (RCT) evaluated the treatment programme of postpartum related pelvic girdle pain. Women who had pain located in the lumbar pelvic area (L5-S1) during pregnancy or within 3 weeks after delivery were asked to complete some diagnostic tests (e.g. PPPP test, ASLR test, pain provocation of long dorsal sacroiliac ligament). Women who had positive results were randomly divided into an experiment group and a control group. The experiment group received physical therapy with specific stabilising exercises. The control group received physical therapy without specific stabilising exercises. The intervention was for 20 weeks with follow-up of pain intensity at one year postnatal (Stuge et al., 2004a). A cohort study explored the association of pelvic girdle pain and disability and pain intensity during late pregnancy and 12 weeks post-

partum. At 30 weeks gestation, women received clinical examinations to diagnose pelvic girdle pain. Tests included the ASLR test, the PPPP test, distraction test, compression test, Patrick-Faber test, palpation of the pubic symphysis and posterior-superior iliac spine. At 12 weeks postpartum they answered a questionnaire to assess physical disability and pain intensity through the DRI and fear avoidance beliefs questionnaires. It was found that pelvic girdle pain was significantly associated with DRI at 12 weeks postpartum. Women who suffered higher pain intensity also had higher DRI (Robinson et al., 2010a).

In addition, studies that consider lumbar and pelvic pain in postnatal women report figures that greatly fluctuate between 2% and 75% (Larsen et al., 1999; Björklund et al., 2000; Líndal et al., 2000; Norén et al., 2002; Stapleton et al., 2002; Mogren, 2007; Thorell and Kristiansson, 2012; Olsson et al., 2012b; Robinson et al., 2014). Larsen et al. (1999) investigated 227 women for pelvic pain during pregnancy and the prevalence between two and twelve months postpartum. It was reported that 14% of women had pelvic pain, whereas postpartum pelvic pain was 5% and 2% at two months and 12 months after delivery respectively (Larsen et al., 1999).

Björklund et al. (2000) evaluated 161 women with back and pelvic pain during pregnancy and eight months after childbirth. It was discovered that 26% of women had persistent back and pelvic pain at eight months after delivery (Björklund et al., 2000). A three-month follow-up study by Líndal et al. (2000), related to low back pain during pregnancy and three months after delivery was investigated. A total of 111 women completed the questionnaires. The results showed that 58.5% of women had low back pain during pregnancy and women who had a prevalence of low back pain at three months postnatal was reported to be 75% (Líndal et al., 2000). A three year cohort study involved women who had back pain during pregnan-

cy and three years postpartum. 28.9% of women had some type of back pain during pregnancy, while 20.1% of women still exhibited back pain after three years (Norén et al., 2002).

LPP negatively affects postnatal women in many of their daily activities, such as carrying and lifting (Gutke et al., 2011). In addition, the pain may have a negative influence on sleep quality and cause depression, fatigue and anxiety (Gutke et al., 2007; Taylor and Johnson, 2013; Cosar et al., 2014). Cosar et al. (2014), used the Pittsburgh Sleep Quality Index to investigate 157 women for the effects of chronic pelvic pain on sleep quality. 80% of women reported poor sleep quality with chronic pelvic pain. Gutke et al. (2007), investigated the association of postpartum depression with LPP. 267 participants completed a questionnaire and diagnosis test at three months postpartum (Edinburgh Postnatal Depression Scale). Following the diagnosis test result, women were divided into four groups (no LPP, pelvic girdle pain, lumbar pain and combined pain). The study found that women in the pelvic girdle pain group, lumbar pain group and combined pain group experienced more depression than the no LPP group. The Taylor and Johnson (2013) study of predicted factors with postnatal fatigue found that anxiety was noted to be a strong predictor of an increase in fatigue and that depression was associated with fatigue and anxiety.

There are many different treatments available to reduce the pain. The most commonly used treatments are exercise, acupuncture, pain medication, therapies using heat, therapies using cold, traction, laser, ultrasound, shortwave diathermy, massage and corsets (Airaksinen et al., 2006; George et al., 2013; Pennick and Liddle, 2013; Perry, 2013). Exercise has been indicated as a beneficial method to relieve LPP during pregnancy and after childbirth (Garshasbi and Zadeh, 2005; Nilsson-Wikmar et al., 2005; Granath et al., 2006; Yan et al., 2014). Retrospective studies have shown that exercise was more effective in decreasing pain and disabil-

ity from low back pain than control treatments or physician consultation (Nilsson-Wikmar et al., 2005; Henchoz and So, 2008). Garshasbi and Zadeh (2005), investigated the effect of exercise during pregnancy on the intensity of low back pain and kinematics of the spine. The results showed significant reduction in the intensity of low back pain after exercise in the exercise group. Nilsson-Wikmar et al. (2005), evaluated 118 women with pelvic girdle pain at three, six and twelve months postpartum. They found that the exercise programme reduced pain and increased activity ability between gestation week 38 and 12 months postpartum. Additional benefits of exercise were found, including improved general health and psychological well-being and decreased musculoskeletal complaints during pregnancy (Hammer et al., 2000; Wadsworth, 2007; Haakstad et al., 2009; Melzer et al., 2010; Prather et al., 2012). In the postpartum period, exercise prevented obesity or being overweight via promotion of body fat or body weight loss, and helped aerobic fitness and strength, leading to an improved ability to perform maternal activities (Larson-Meyer, 2003).

In health care research, different delivery modes for exercise programmes have been used such as leaflets, booklets, videos, computer and Internet-based information as an intervention to understand which instruction can improve adherence to exercise. Gaston and Gammage (2011), used a brochure as an intervention and randomised 89 pregnant women into an experimental group and a control group. Women in the experimental group were read a brochure about the health benefits of postpartum exercise, whereas women in the control group were not given any information. The aim was to examine the health-based message on pregnant women's intentions to postpartum exercise (Gaston and Gammage, 2011). Szmeja et al. (2014), compared the effectiveness of educational Digital Versatile Disc (DVD) and standard written materials on pregnant women with healthy food choices and exercise

(Szmeja et al., 2014). Jones et al. (2013), used an online intervention of cognitive behaviour training for the prevention of postnatal depression in at-risk mothers (Jones et al., 2013).

Technology is being increasingly used in health care and research has revealed the success of DVD interventions to improve the uptake of exercise among cardiovascular outpatients and those with Huntington's disease (Vickers et al., 2011; Khalil et al., 2012). Internet-based or web-based interventions also illustrate the impact of physical activity on osteoarthritis and multiple sclerosis (Motl et al., 2011; Bossen et al., 2013). Motl et al. (2011), used an Internet based intervention to increase physical activity of multiple sclerosis patients. A total of 54 participants were randomly put into an experimental group and a control group. Participants involved in the experimental group were supplied with information via a web site for the Internet intervention. After 12 weeks of intervention, it was found that patients in the experiment group had larger increases in physical activity compared to the control group. Bossen et al. (2013), developed a tailored physical activity programme for osteoarthritis patients. The nine-week programme to improve patient's physical activity was via a web site. It was a pilot study to investigate the effectiveness, feasibility and acceptability of physical activity programmes for osteoarthritis. 20 participants attended the preliminary study. Testing results found physical activity increased and the intervention was feasible and acceptable in promoting physical activity in patients.

The Internet has been used as a new method to communicate with people, introducing products, ideas and information. Comparing it with other media, the Internet is more economical, quicker and more up-to-date. With the assistance of the Internet, people find it easier to make well-informed decisions with the extended knowledge, and the effectiveness

of communication are significantly improved. This is of particular importance in the context of health care (Jadad et al., 2000).

Social media is a powerful tool that enables users to cooperate with each other. Additionally, it is a technology that allows various people the opportunity to interact socially. With regards to the practice side of health communication, social media outlets may represent an excellent opportunity to reach traditionally underserved members of the population (Moorhead et al., 2013). Moreover, social networking websites such as Facebook have been shown to provide potential for the delivery of public health intervention programmes (Chou et al., 2009). Recent advances in technology provide the opportunity to use friendly and potentially interactive modes of communication in health promotion interventions. Interactive media interventions are often computer-delivered (via the Internet or CD-ROM). The benefits of interactive media interventions include incorporation of rich media, immediate and often tailored feedback, greater participant action and control, flexibility to participate in the programme at the participants' convenience and the potential for wide programme reach (Mauriello et al., 2007).

Social media tools such as Facebook, YouTube and Twitter are extensively used in an upward trend in disseminating the health message, particularly for women who intend to use social media platforms for social purposes, such as blogging, sharing information and photos, maintaining social interaction with families and friends, as well as seeking self-help information and entertainment (Piombino, 2014).

Taking advantage of social media, some research centres have already applied it in all sorts of interacting activities with their stakeholders, such as running health communication campaigns and activities, and involvement in emergency response. There are great advantages in

applying social media in this context. Disseminating health and safety information and its potential impacts can help people make well-informed decisions and safer and healthier choices. Audiences could benefit from information sharing, and the information can be spread to wider and more diverse audiences. Health messages could be targeting specific types of audiences by being tailored and made more personalised. Eventually, the goal of information sharing, facilitating communication in an interactive style, and connecting and engaging with the public can be achieved (CDC, 2011).

Study setting – Taiwan

In Taiwan, 74.9% of women report lumbar pelvic pain during pregnancy, with rest being the chosen method of these women to manage pain (Chang et al., 2011). Taiwanese new mothers reduce their physical activity after birth, a tradition that is well embedded in Taiwanese culture and is known as 'doing the month'. This is believed to be a way to protect bone and muscles (Holroyd et al., 2005; Tung, 2010). Currently, a new mother receives verbal advice from nurses before her release from hospital and a leaflet which describes a set of exercises to manage postpartum lumbar and pelvic pain (sometimes just referred to as back pain). Furthermore, nurses also instruct mothers in relation to postnatal exercises with the assistance of the leaflet. The exercise programme in the leaflet has been recommended to women for several years and has been available in the literature from the Obstetric Nursing Book at least as far back as 1971 (Lee et al., 1996). This researcher has ascertained that in Taiwan, thirty hospitals (thirteen medical centres and seventeen metropolitan hospitals) recommend postpartum exercises for women during the one to three day gap between the end of labour and leaving for home. Out of 30 hospitals, 93.3% of them (n=28) have been using individual instruction, whereas 7.7% of them employ group instruction (n=2).

Use of the Internet in the form of dial-up, leased line, XDSL, cable modem, ISDN, fibre, broadband and mobile in Taiwan has grown significantly, since the year 2000 when over 6 million out of the entire population of 22 million were Internet users. According to Internet World Stats, people who have active Internet access accounts in Taiwan have nearly reached 20 million. With a population of over 23 million, the proportion of Internet users in the population has reached 87.9% (Internet World Stats, 2018) (table 1).

Table 1: Internet usage and population statistics in Taiwan.

YEAR	Users	Population	% Pop.	Usage Source
2000	6,260,000	22,300,929	28.1 %	ITU
2004	12,200,000	22,794,795	53.5 %	FIND
2006	14,500,000	23,001,442	63.0 %	FIND
2014	18,687,942	23,359,928	80.0 %	ITU
2016	19,666,364	23,464,787	83.8 %	ITU
2017	20,821,36	23,694,089	87.9%	FIND

(Internet World Stats, 2018)

Most Internet users are female, with the longest amount of time spent online for information seeking and collection. As far as exercise intervention is concerned, despite the popularity of social media networks and the availability of Internet connections, there has been

little research suggesting the effectiveness of delivering these messages to postpartum women in Taiwan. To address the absence of such a comparison, i.e. women's application of such knowledge in life, prior to and after receiving exercise intervention, this paper aims to identify the effectiveness of such messages by tracking the audience concerned. The study details and outcome are stated in detail in Chapters 3 to 6.

In a preliminary scoping study, the researcher explored the uptake of exercise among twenty women who received the postpartum exercise leaflets from hospital. All of the women reported that they did not use the leaflets to follow the exercise programme. The reasons given for not using the leaflets included losing the leaflet, low motivation, not enough time and childcare duties. Therefore, this study assesses the effectiveness, uptake, adherence and completion rate of three modes of delivery of exercise regimes for lumbar-pelvic pain in post-partum women in Taiwan.

1.2 Aim

The aim of the Phase 1 systematic review was to synthesise the evidence relating to the effectiveness of various exercise programmes on lumbopelvic pain (LPP). The Phase 2 PRCT study was to assess the acceptability (uptake, adherence and completion rate) and effectiveness of DVD and Internet-based exercise interventions on postpartum LPP in Taiwanese women, compared to typical instruction through leaflets.

1.3 Objectives

1.3.1 To develop an evidence base for the effectiveness of exercise interventions on postpartum LPP. (Phase 1)

1.3.2 To compare the effectiveness of three methods of instruction of exercise on postpartum LPP: DVD-based, Internet-based and leaflet based. (Phase 2)

1.3.3 To compare the acceptability (uptake, adherence and completion rate) of three modes of delivery: DVD-based, Internet-based and leaflet based. (Phase 2)

Chapter 2

Literature Review

This chapter presents a review of the literature on LPP; acceptability of exercise in the general population of women; exercise regimes among pregnant/postpartum women with LPP; and the medium of instruction of exercise in health care. The chapter also reviews the literature regarding the theoretical framework adopted in the study.

The review starts with a definition of LPP from an aetiological perspective and discusses LPP incidence and the possible causes of LPP such as increased abdominal diameter, higher body mass index (BMI), muscle dysfunction. It then considers the common diagnostic measures of LPP before moving forward to comment on pain management by using different interventions including exercises, acupuncture, pain medication, and various therapies.

As the main method under consideration for this study for reducing LPP after pregnancy, acceptability of exercise in the general population of women is discussed.

The chapter also reviews the literature on women exercising during pregnancy and after child birth, and the, barriers to exercise among pregnant and postnatal women.

Literature on the medium of instruction of exercise is also presented in the chapter. The chapter concludes with the literature on multimedia learning theory which was the theoretical framework that was used as the basis for conceptualising the different modes of exercise instruction.

2.1 LPP in pregnancy and the postpartum period

2.1.1 Definitions and symptoms

While back pain in general is discussed in relation to anatomical regions, such as the neck or lower back, Olsson et al. (2012a) defined LPP as self-reported pain in the region of the lower back and/or anterior and/or posterior region of the pelvis. The presence of LPP is often identified and confirmed by self-reported pain location, alone or in combination with clinical tests and is often based on diagrammatic representations of areas of pain. (Nilsson-Wikmar et al., 2003; Nilsson-Wikmar et al., 2005; Gutke et al., 2010a; Robinson et al., 2010b; Malmqvist et al., 2012; Olsson et al., 2012a).

Lower back pain may refer to pain, muscle tension or stiffness occurring between the costal margin and gluteal folds. Some people may also refer lower back pain to the upper legs (Walker, 2012). European guidelines have defined pain in the pelvic region as the pain experienced between the posterior iliac crest and the gluteal fold, principally in the vicinity of the sacroiliac joint. The pain could combine radiating pain in the posterior thigh or in the symphysis location (Vleeming et al., 2008). Gutke et al. (2010a), classified LPP in pregnant and postpartum women based on the following criteria: 1) Pain experienced in the lumbar region, with or without radiation to the leg, 2) Reproducible pain and/or a change in the range of motion from repeated movements or different positions of the lumbar spine or an experience of centralisation and/or peripheralization during examination, 3) Fewer than two positive pelvic pain provocation tests.

2.1.2 Location of pain

A number of studies have investigated and reported the locations of LPP among women during pregnancy and in the postpartum period with most of the studies focusing on LPP locations during pregnancy. Ayanniyi et al. (2006), examined the pattern of the location of pain among 1008 pregnant women and found that low back (66.4%), posterior pelvic (24.0%) and high back (9.6%) were the most reported sites of pain. Skaggs et al. (2007), reported that in the second trimester, pregnant women with back pain experienced pain at three sites that include low back pain, pelvic pain and mid-back pain. In this study, nearly half of the women presented with a multi-focal pattern of pain involving two or more sites. Malmqvist et al. (2012), reported lumbosacral and sacral regions as the most commonly reported locations.

Mens et al. (2012b) studied women with LPP and pain-related signs and symptoms between 20 to 30 weeks pregnancy. The women in their study reported the pain locations as: posterior pelvic bilateral (36.4%), posterior pelvic unilateral (24.2%), posterior pelvic bilateral and pubic symphysis (13.1%), coccyx only (11.1%), and low back pain only (7.1%). Another study by Al-Sayegh et al. (2012), from Kuwait which evaluated the prevalence of pregnancy-related LPP in Kuwait found the pain locations as: lower back only (36.2%), lower back and pelvic girdle (29.1%) and pelvic girdle (13.8%). Pierce et al. (2012), investigating the prevalence and nature of LPP, found that 17% of women reported pain in the low back only, 33% described pain in the pelvic girdle only and 50% reported pain in both low back and pelvic girdle.

Studies have reported varying locations of pain in the pelvic girdle during pregnancy. A study by Robinson et al. (2006), found 19% of women experienced pain in the anterior pelvis only, 14% experienced uni- or bilateral pain in the posterior pelvis, 4% experienced pain both in the anterior and unilateral posterior pelvis and 5% experienced pain in the anterior and bi-

lateral posterior pelvis. In addition, a cohort study by Bjelland et al. (2010), discovered that of the 58% of women reporting pelvic pain during pregnancy, 15% had pain in the anterior and bilateral posterior pelvis. In another prospective cohort study investigating women with pelvic girdle pain in late pregnancy and up to 12 weeks postpartum, Robinson et al. (2010a), found more than half of the women experienced pain in the posterior pelvic location only (55%).

Varying locations of low back pain have also been reported with pregnant women often describing that the pain originated from the lumbar spine location. A quantitative study by Wang et al. (2004), noticed that the pain occurred in the upper back, the lower back and the upper and lower back. Furthermore, Ansari et al. (2010), reported that in 40.7% of women the pain onset was most frequently reported in the third trimester of pregnancy and the pain location was often reported to be in the low back area.

Locations of pain in the postnatal period appear to be varied and often mixed. For example, the most frequently reported pain location in one study was the low back (56.4%) followed by the sciatica (26.8%) About one in ten women reported mixed low back and sciatica pain (10.4%) (To and Wong, 2003). Another study found 33.3% of postnatal women experiencing back pain in the lumbar region, 43.6% women in the posterior pelvic region and 2.1% women with combined lumbar back and posterior pelvic pain (Norén et al., 2002). In addition, Nilsson-Wikmar et al. (2003) identified that postpartum back pain could be provoked in the posterior pelvic/sacroiliac joints, in the lumbar spine, both in the posterior pelvic/sacroiliac joints and in the lumbar spine. The results of their study demonstrated that postpartum women had pain location in the lower back areas at six to ten months after delivery (Nilsson-Wikmar et al., 2003). Vøllestad and Stuge (2009), diagnosed seventy-eight women at 6–16

weeks postpartum with pain in the pelvic girdle. They stated that '13% of postnatal women had pain located to the symphysis only, 24% reported pain in all three pelvic joints and 63% had pain in the symphysis and one sacroiliac joint or in one or two sacroiliac joints' (Vøllestad and Stuge, 2009, p720).

In summary, existing studies have provided an in-depth understanding of the localisation of pain. Findings from most of the studies show that LPP locations reported by pregnant and postnatal women included lower back, posterior and anterior pelvic, and lumbosacral.

2.1.3 Aetiology of LPP

The cause of LPP during pregnancy and postpartum is not entirely clear. Hormonal, biomechanical, musculoskeletal and postural changes are the most frequently reported reasons for pregnancy-related LPP. Hormonal changes are believed to be responsible for the early onset of lower back pain in pregnancy as the increases in some of the hormones makes the spine and pelvic structure more flexible. For example, association between high serum relaxing levels and pelvic pain and joint laxity during late pregnancy has been reported (Maclennan et al., 1986). Biomechanical and musculoskeletal changes during pregnancy are also been increasingly believed to be responsible for pain in the back.

During pregnancy, women gain approximately 20 to 40 pounds extra load. The body mechanics changes that occur while the carrying the baby in the womb result in the body's centre of gravity shifting anteriorly and increasing the momentum of forces applied to the lumbar spine (Sabino and Grauer, 2008). Furthermore, as the baby grows, the abdominal diameter will increase, and, in some women, the elongated weakened abdominal muscles will lead to insufficient muscle force in dynamic stabilisation of the sacroiliac (SI) joints (Elden, 2008a). When a woman is pregnant, the rectus abdominis muscles, which cover a wide area of the

anterior abdomen from the xiphoid process to the pubic symphysis, go through transformation. As the foetus develops, the linea alba (a fibrous structure that runs down the midline of the abdomen) becomes much longer, and as the abdominal wall becomes larger, it can be observed to curve round (Champion, 2015). Moreover, most of the separation takes place in the umbilicus (Boissonnault and Blaschak, 1988). In LPP related to diastasis of the recti abdominis, there is a higher chance that a woman with the condition will have a higher degree of pain in the abdominal and pelvic region (Parker et al., 2009). Additionally, postural changes may be implemented by the women to balance the anterior shift, leading to lordosis. This increases the natural inward curvature of the spine and stress on the lower back (Sandler, 1996).

It has also been postulated that posture changes during pregnancy and postpartum may lead to LPP. The spine (vertebral column) consists of 33 vertebrae descending from the cranium to the coccyx. The anatomical structure of the spine includes seven cervical (neck) vertebrae (Cl-C7), twelve thoracic (upper back) vertebrae (Tl-T12), five lumbar (lower back) vertebrae (Ll-L5). Spinal curves include four natural curves which are visible in the coronal plane and form an 'S'-like curve. The cervical spine curves slightly inward, the thoracic slightly outward and the lumbar slightly inward. This produces a gentle rounding of the shoulder and a curve in the lower back. These curves balance the body in standing, sitting and lying, producing an even weight distribution and helping to withstand mechanical stress (Swann, 2012) (See Figure 1). Predictably, most back pain is located in the lumbar area, which is responsible for supporting the majority of the weight of the upper body (Walker, 2012). The pelvis is composed of the two pelvic bones, sacrum and coccyx. The pelvic bones include the ilium, the ischium, and the pubis (See Figure 2). The relationship between the pelvis and lumbar spine is that the lumbar spine sits on the sacrum. Any change in the posture of the pelvis, and

therefore, posture of the sacrum, directly changes the posture of the lumbar spine (Muscolino, 2012). Thus, the posture changes during pregnancy and postpartum may lead to LPP. For example, Bullock-Saxton (1991), examined posture changes in 59 women during pregnancy and during the early postnatal period. The study measured spinal curvature and pelvic inclination at fourth and ninth months of pregnancy and two months postpartum. The results found the lordosis and kyphosis had increased significantly during pregnancy and that these spinal curvatures were maintained up to two months postnatal.

Okanishi et al. (2012), used the sagittal plane with static digital pictures to compare the pregnant and non-pregnant women's posture changes. Pregnant women reported postural characteristics of lumbar kyphosis and sacral posterior inclination. The impact of spinal curvature and postural changes may relate to low back pain and pelvic pain symptoms during pregnancy. Pregnant women may cause changes in spinal curvature and postures which may in turn lead to related symptoms. However, LPP may be concentrated in the posterior pelvic area and it may shift localisation from lumbar to sacral and can also be accompanied by pain in the pubic symphysis. Pain was described as a pulling sensation, followed by descriptions of shooting sensations, aching sensations, and a combination of two or more sensations. More than half of pregnant women with LPP reported that the standing position aggravated their pain, followed by the sitting position, bending position, lying position, and walking position (Wang et al., 2004; Al-Sayegh et al., 2012). Pain was mostly described in the low back area. Women experienced the pain sometimes as radiating pain, mainly to the knees or to the buttocks, which is exacerbated by standing and/or sitting for lengthy periods and when turning in bed (Ansari et al., 2010). The pain is often worse in the evenings and at night. Likewise, the evening pain is often related to the amount of activity during the day (Eggen et al., 2012; Stafne et al., 2012).

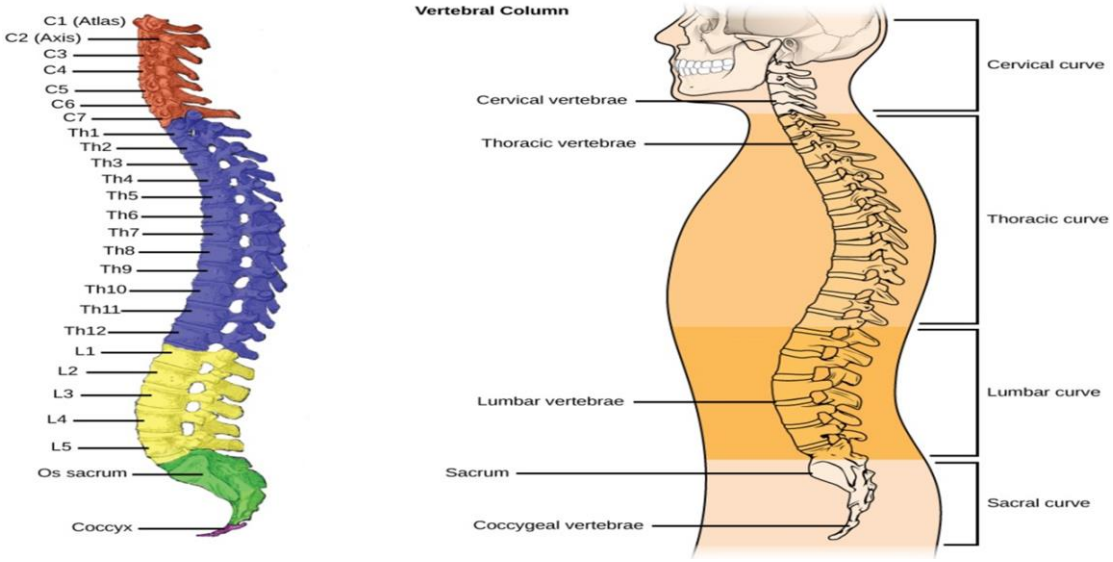


Figure 1**:** The Vertebral Column.

[Online]:http://files.differencebetween.com/wpcontent/uploads/2014/03/Spinal-Column-Vertebral-Column.png

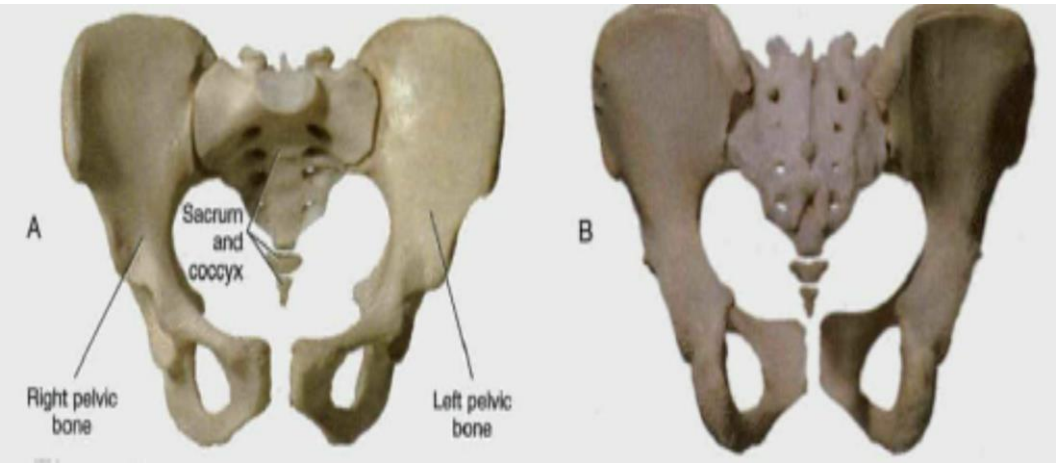


Figure 2: The Pelvic (Muscolino, 2012).

2.1.4 Incidence and risk factors

Studies have reported varying prevalence of LPP in pregnancy and in the postnatal period. For example, a large sample survey of 1531 south Australian women reported that 13% of women had low back pain more than one year after pregnancy (Stapleton et al., 2002). A cohort study by Robinson and colleagues investigated 215 pregnant women in Norway with pelvic girdle pain at 30 gestation weeks with follow-up one year postpartum. They found that 63% of women had pelvic girdle pain during pregnancy and the prevalence of pelvic girdle pain was 30 % at one year postpartum (Robinson et al., 2014). Mukkannavar et al. (2013), used a cross-sectional study to determine the prevalence of pelvic girdle pain in postpartum women in India. 284 postpartum women participated in the study and the prevalence of pelvic girdle pain in postpartum women was 41%. Gutke et al. (2011), evaluated the prevalence of LPP at three months postpartum in Sweden. The study found 33% of postpartum women experienced LPP during pregnancy to three months postpartum.

Of the potential risk factors for lumbar and pelvic pain during pregnancy, it has not yet been possible to establish one single dominant causative factor. Studies have considered the risk factors, such as use of oral contraceptives, smoking during pregnancy, spinal or epidural anaesthesia, number of pregnancies, LPP during menstruation, multiple gestation, and age (Wang et al., 2004; Al-Sayegh et al., 2012; Clark et al., 2013). Albert et al. (2006), used questionnaires and physical examinations of 2,269 pregnant women to identify possible risk factors for developing four different syndromes of pelvic girdle pain during pregnancy. This study found the risk factors for developing pelvic girdle pain in general included a history of previous low back pain, trauma of the back or pelvis, multivariate, higher level of stress, and low job satisfaction (Albert et al., 2006). Chang et al. (2012), investigated 183 pregnant

women with LPP for pain-related psychological and social factors in northern Taiwan. The result showed that lower education level was associated with higher pain intensity. Additionally, the variable age moderates the association between pain intensity and pain interference (Chang et al., 2012). Chang et al. (2014), identified the risk factors associated with changes in pain intensity and interference over time. From 179 pregnant women they found that increases in pain interference were predicted by both biological and psychological factors. The findings supported the effectiveness of a biopsychosocial model for understanding pregnancy-related low back pain and indicated directions for designing clinical interventions to better manage pregnancy-related low back pain (Chang et al., 2014).

Several different physical and psychosocial factors have been found to correlate with self-reported pain (Mens et al., 1996; Al-Sayegh et al., 2012; Mukkannavar et al., 2013). An increased abdominal diameter, higher BMI, muscle dysfunction, and foetal weight are clearly associated with low back pain and pelvic pain during pregnancy (Östgaard et al., 1993; Garshasbi and Zadeh, 2005; Mogren, 2006; Parker et al., 2009). Parker et al. (2009) investigated the relationship between diastasis recti abdominis and LPP in postpartum women. There was a significant correlation between women with or without a diastasis recti abdominis compared with LPP. It supported the link between woman with a diastasis recti abdominis and a higher degree of pain in the abdominal and pelvic region.

Mogren (2006), reported women with higher maternal age and higher BMI are more likely to have low back pain and pelvic pain during pregnancy and after pregnancy. Women who had high BMI experienced a higher level of pain during pregnancy and postpartum. However, the main factors associated with the development of lumbar and pelvic pain was previous episodes of back pain while non-pregnant or pregnant. The occurrence of back pain during

pregnancy did not affect the pregnancy outcome. The main risk factors associated with persistent back pain at 24 months appeared to be the onset of severe pain at early gestation , as well as the inability to reduce weight to their pre pregnancy level (To and Wong, 2003). However, LPP, especially after pregnancy, can impact negatively upon the ability to perform daily activities and on the quality of life. Amongst postnatal women, LPP has been shown to lead to sleep problems, depression, fatigue and anxiety, and a general inability to carry out activities that involve carrying or lifting (Ko et al., 2008; Cramp and Bray, 2010; Ko and Lee, 2014). For instance, Gutke et al. (2007) found that women suffering from LPP are three times more likely to have postpartum depressive symptoms compared to those without (Gutke et al., 2007). In another study, 40% of women with postpartum LPP reported moderate to severe disability, with pain intensity being the major explanation for the level of disability (Gutke et al., 2011).

2.1.5 Diagnosis and assessment of LPP

Clinical tests of LPP diagnosis during pregnancy usually include the ASLR test, PPPP test, sacroiliac joint pain provocation test, and lumbar spine pain provocation test (Albert et al., 2000; Vleeming et al., 2008; Mens et al., 2012a). Studies evidenced the ASLR test has shown to be a reliable instrument to measure pain severity in pregnancy-related LPP (Mens et al., 1999; Mens et al., 2001; Mens et al., 2002). Moreover, the ASLR tests and the PPPP tests of the sacroiliac joints and the low back are commonly used in clinical practice and are considered useful in differentiating between the many potential sources of pain in the area and the ability to transfer load across the lumbopelvic region (Vleeming et al., 2008; Ando and Ohashi, 2009; Mens et al., 2012a).

However, diagnosis of LPP during pregnancy involves recording a detailed history and symptoms because there are few tests available to aid in diagnosis, for fear of harming the foetus (Sabino and Grauer, 2008). A detailed history information includes location, onset, radiation (whether the pain radiates to the legs), exacerbating and relieving factors (whether the pain is worse after rest or movement), associated symptoms, and severity (Walker, 2012). Therefore, evaluation of low back pain during pregnancy is difficult because the pain is subjective and usually the result of a combination of problems. The evaluation of LPP is mostly based on self-administered questionnaires or interviews, and the LPP is occasionally assessed by clinical evaluation.

A commonly used method to measure LPP and pain intensity during pregnancy (Al-Sayegh et al., 2012; Pierce et al., 2012; Stafne et al., 2012) and postpartum (Gutke et al., 2011; Olsson et al., 2012a) is the VAS. The VAS is a subjective, self-reported measure of pain intensity in clinical and experimental settings, which is a self-administered measure that takes up to one minute to complete (Kane et al., 2005). Women are instructed to mark their perceived level of pain intensity on the 10cm line. The VAS is scored by measuring the distance (in millimetres), from the 'no pain' anchor to the mark placed on the line by the client. The resulting measure represents the client's level of pain. Possible scores range from 0 – 100 (Finch et al., 2002). Higher scores represent more pain. The meaning of the scale line has been defined by different researchers, such as a score of > 30mm being equal to or greater than 'moderate' pain, while a score of > 54mm is equal to or greater than 'severe' pain (Huskisson, 1974 ; Collins et al., 1997). Jensen et al. (2003) identified the meaning of the scale line as 0-4 mm for no pain, 5-44 for mild pain, 45-74mm for moderate pain and 75-100mm for severe pain (Jensen et al., 2003).

Additionally, the DRI, which has been used for measuring pain in patients undergoing rehabilitation for neck, shoulder and lower-back pain, and for measuring post-partum back pain in previous studies (Nilsson-Wikmar et al., 2003; Nilsson-Wikmar et al., 2005). 'The DRI is a 12-item questionnaire that allows evaluation of a physical function. The DRI includes the following activities: dressing; outdoor walks; climbing stairs; sitting for a longer time; standing bent over a sink; carrying a bag; making a bed; running; light work; heavy work; lifting heavy objects; and participating in exercise/sports' (Longo et al, 2010, p.126).

2.1.6 Exercise in the management of LPP

In sports psychology, exercise is a broad concept that is linked to physical activity. As a generic concept, as defined by the scholar Anshel (1991), physical activity involves energy consumption at higher levels compared with the resting metabolism of the human body. It has also been defined as 'an activity in leisure-time (Bouchard et al., 1990). Caspersen et al. proposed the concept of physical activity as having at least three elements, namely: displacement of the body produced by skeletal muscles; causing energy consumption change from low to high; the positive impact on the constitution of body (Caspersen et al., 1985). The concept of physical exercise include the first two elements of physical activity, but it is to maintain and improve physical fitness on the basis of planned, duplicated content and engaged in body movement (Caspersen et al., 1985).

2.1.6.1 Guidelines relating to exercise in LPP treatment

Healthcare guidelines recommend that people exercise to relieve back pain, including actions such as the bottom to heels stretch, knee rolls, back extensions, deep abdominal strengthening and pelvic tilts (NHS, 2017). In addition to some simple back exercises and stretches, to help managing the back pain, the National Health Service (NHS) in England en-

courages patients to continue their daily normal activities. If the pain remains, it is advisable to take painkillers such as non-steroidal anti-inflammatory drug (NSAID) tablets to relieve it (NHS, 2017). The 'Dutch Physiotherapy Guidelines for Low Back Pain' recommended that patients stay active instead of bed rest or take an exercise intervention as treatment to chronic low back pain(Bekkering et al. 2003). Exercise can be considered as adding the value of physiotherapy combination modalities such as using hot packs, massage, traction, mobilisation, short wave therapy, ultrasound, stretching exercises, mobilisation exercises, improving coordination, and electrotherapy. The 'European Guidelines for the Management of Pain' recommended that women take exercise during pregnancy and individualised treatment programmes (specific stabilising exercises) afterwards -at postpartum stage- to relieve the pelvic girdle pain (Vleeming et al., 2008). Clinical guidelines for the management of low back pain recommend low-stress aerobic exercises to reduce acute LBP. McKenzie exercise therapy is one of them and can treat acute or chronic LBP (Koes et al., 2001).

2.1.6.2 Exercise in the management of back pain in general

There is evidence that the core stability exercises can reduce back pain with positive results. A retrospective study used the device-based physical therapy programme to assess low back pain. Participants received the pain control and the McKenzie lumbar spine exercises over six weeks. The exercises included lumbar flexion and extension. In this study, it was established that the device-based physical therapy program could reduce low back pain (Anandani et al., 2015). A further study compared the general conditioning exercises and McKenzie exercises for patients with low back pain. The findings demonstrated that the McKenzie exercises are proven more effective in reducing the pain (Yamin et al., 2016). Moon et al. (2013) compared two types of exercises - lumbar stabilisation exercises consisting of 16 exercises to

strengthen the deep lumbar stabilising muscles and conventional lumbar dynamic strengthening exercises consisting of 14 exercises - on patients with chronic low back pain. Patients were randomly allocated into two groups for 8-week training of lumbar stabilisation exercises and lumbar dynamic strengthening exercises. The results proved that both exercises improved lumbar muscles' functionality and decrease the pain intensity (Moon et al., 2013).

Additionally, a RCT study compared the effects of muscle energy technique and core stability exercises with non-specific chronic low back pain patients. Ninety-six patients were randomly allocated into four groups and given eight weeks' intervention. The intervention these four groups received included muscle energy technique, core stability exercise, combined treatment (muscle energy technique and core stability exercise), and no treatment. It was found that the pain intensity of those in the combined treatment group was reduced most, followed by those in the muscle energy technique group and core stability exercises group. This study found that the patients using the muscle energy technique or core stability exercises could reduce the low back pain, although the more beneficial intervention was the combination of both treatments (Akodu et al., 2017).

Kliziene et al. (2015), demonstrated that the core stability exercises could affect multifidus muscles function to reduce the low back pain. Core stability exercises programme lasts for 45 minutes and is undertaken twice a week during an 8 months' training period. Women who had low back pain reported improved pain intensity after exercise training. Akodu et al. (2015) conducted four different types of treatments, which includes stabilisation exercise, transcutaneous electrical nerve stimulation, massage therapy, and drug therapy, for patients with non-specific chronic low back pain. A total of 122 participants finished these treatments within eight weeks. It was found that stabilisation exercise was more effective for low

back pain. Another review has also shown that the core stability exercise is more effective compared with general exercises for LBP patients with non-specific low back pain to decrease pain and increase back-specific functional status (Coulombe et al., 2017).

Certain studies have investigated the effect of general exercises for low back pain. Unsgaard-Tøndel et al. (2010), compared the motor control exercise, sling exercises and general exercises for low back pain. The general exercises include trunk extension, flexion, and rotation with resistance and stretching of trunk and extremity muscles. The authors found that general exercises reduce the pain and disability in the early phase of low back pain. A similar study investigated three groups of participants who suffered from low back pain and received different interventions (ultrasound guided exercise, sling exercise, and general exercise) for eight weeks. The authors found that if patients have 6-8 treatments with ultrasound guided exercise, sling exercise and general exercise, some pain could be reduced (Vasseljen and Fladmark, 2010).

2.1.6.3 Exercise for pain management during pregnancy

Exercise in pregnancy has been linked to reduction in low-back pain and pelvic girdle pain. For example, a birth cohort study on 3482 pregnant women investigated the association between different types of self-reported exercises including brisk walking, skiing, commuting to work by bike and sports in mid-pregnancy, and low-back pain, pelvic girdle pain at 32 weeks of pregnancy. This study confirmed that pregnant women exercising ≥3 times a week were less likely to report pelvic girdle pain, while women exercising one to two times a week were less likely to report low-back pain (Gjestland et al., 2012). Kihlstrand et al. (1999), randomised 258 pregnant women with back or low back pain into a water-gymnastics group and a control group. The intervention of the water-gymnastics group was to exercise once a week

during the second trimester of pregnancy. The authors found that the water-gymnastics group had significantly reduced the intensity of back/low back pain and decreased the number of women on sick leave because of back/low back pain. In addition, a RCT was conducted to assess the efficacy of Hatha yoga exercises in pregnant women with LPP. At 12 to 32 weeks, pregnant women were divided into the yoga group and the postural orientation group. The yoga group did one hour yoga sessions for 10 weeks. The postural orientation group performed standardised posture orientation according to instructions provided in a pamphlet. In this study, the result for LPP intensity was that the yoga group exhibited decreased pain to a greater extent than the postural orientation group (Martins and Pinto e Silva, 2014). Yan et al. (2014), used an antenatal stability ball exercise programme on an experimental group to compare a control group with low back pain during pregnancy. After 12 weeks' intervention, the experimental group had significantly less low back pain and daily life interferences than the control group at 36 weeks of gestation.

Clinical approaches for LPP management have specified the importance of activation of muscles for motor control and stability of the lumbopelvic region (Richardson et al., 1999), and physical exercise has been indicated as one of the beneficial methods to relieve LPP during pregnancy (Garshasbi and Zadeh, 2005; Nilsson-Wikmar et al., 2005; Granath et al., 2006; Yan et al., 2014). While different exercise programmes exist, part of the literature to date suggests that the use of exercise programmes during pregnancy may provide effective pain management for women with LPP. For example, a case report found that a woman of 32 weeks' gestation with LLP who received chiropractic care, including massage therapy (chiropractic spinal manipulation, soft tissue massage), and daily exercises (low back stretches and pelvic floor strengthen) for six weeks, reported a reduction of LPP after treatments (Bernard and Tuchin, 2016). Ozdemir et al. (2015), demonstrated that women with pregnancy-related

low back and pelvic pain who received the exercise programme for four weeks, have reported reduced pain intensity. The exercise programme included stretching, tightening and loosening movement on a mattress, and walking.

A RCT study by Martins and Pinto e Silva (2014), compared yoga and postural orientation intervention to understand which intervention can reduce lumbopelvic pain in pregnancy. In this case, 60 pregnant women who reported lumbopelvic pain at 12 to 32 weeks of gestation were divided into two groups (yoga group and postural orientation group). Women in the yoga group practised 34 poses and breathing exercises once a week for one hour. Pregnant women in the control postural orientation group received a booklet that contained figures and text to explain possible changes in the curvature of the vertebral spine during pregnancy. After 10 weeks intervention, the results established that women in the yoga group had lower pain scores in comparison to the postural orientation group. The authors stressed that yoga can be more effective in reducing lumbopelvic pain intensity (Martins and Pinto e Silva, 2014).

Kokic et al. (2017), developed an exercise programme which included stabilization exercises, stretching and pelvic floor exercises. It was an RCT design, 22 women received the exercise program and 23 women received only standard antenatal care. After a six weeks' intervention, the study found that women following the exercise program had less pain intensity during pregnancy. Yan et al. (2014), evaluated 89 pregnant women with low back pain over the course of a 12-week stability ball exercise programme using the Swiss ball. The stability ball exercise programme included 14 stabilisation exercises and aimed to train up the transversely-oriented abdominals, the lumbar multifidus, and pelvic floor muscles. They found the sta-

bility ball exercise improved the daily life interferences and relieve the low back pain at 36 weeks of gestation.

Thus, it can be seen, exercise programmes are widely used to help women with back pain during pregnancy. A systematic review conducted on the effectiveness of group exercise training and usual antenatal care of LPP among pregnant women. As part of the review, five randomised controlled trials (RCTs) were included and considered good methodological quality. It was concluded that the group exercise training could be more effective than usual antenatal care of treatment of LPP during pregnancy (Fisseha and Mishra, 2016).

A few studies have also reported negative findings with respect to the effectiveness of exercise for relieving LPP during pregnancy. For example, Sedaghati et al. (2007), used an exercise programme consisting of extension movements and cycling for women with low back pain during pregnancy. Participants in the exercise group were doing three sessions per week and continued the exercise program for eight weeks. After taking the intervention there were no significant results in relation to pain intensity between the exercise group and the control group, instead, the low back pain became worse slightly in the exercise group. However, this study was limited by the lack of participants back pain history and exercise design may have prevented the increase in back pain that may have resulted from the advancement of the pregnancy.

In another study by Stafne et al. (2012), 855 women were randomly allocated to an exercise programme group and standard care group for 12 weeks. The exercise programme group received aerobic activity, strength training, and balance exercises, whilst the standard care group received the customary information without any encouragement for exercise. Results found no significant difference between both groups of reducing LLP. The exercise pro-

gramme group had fewer sick leaves due to LPP. Some of the limitations of the study include lack of clear definition of outcome (no clear definition between low back pain and pelvic girdle pain) and lack of objective selection of case, which may lead to selection bias.

An observer-blinded randomised controlled trial was designed by Eggen and colleagues. They compared a group-based exercise programme and standard care on pregnant women, trying to establish the effectiveness of exercise on reducing the prevalence and severity of low back pain. The supervised exercise programme contained group-based exercises and home exercise and aims to achieve efficient motor control and dynamically control to eventually improve the stabilisation of the lumbopelvic region during daily activities. Results revealed that the exercise programme did not reduce the prevalence of low back pain that occurred during pregnancy (Eggen et al., 2012). In addition, Kordi et al. (2013), found that those women with pelvic girdle pain who used the lumbopelvic belt and the home-based pelvic stabilising exercise, experienced reduced pain. The study ascertained that women using the lumbopelvic belt suffered from less pain intensity than those doing pelvic stabilizing exercise. The authors indicated that the study had no effect on the pelvic stabilising exercise due to the short follow up time. In this study, participants were only followed-up for six weeks postpartum. However, the authors suggested that a longer follow up time could have been more helpful in understanding the effect of lumbopelvic belt and the home-based pelvic stabilising exercise on LPP among postpartum women.

Another study by Haakstad and Bø (2015), randomly assigned 105 pregnant women to exercise group and control group. Women in the exercise group participated in the intervention for 12 weeks and received endurance training and strength training. The control group con-

tained no exercise intervention. In this study, there was no significant difference between the exercise group and control group in terms of LLP.

2.1.6.4 Exercise for pain management for postpartum women

A systematic review of RCTs on the effectiveness of exercise programmes on LPP among postnatal women was conducted to meet one of the objectives of the current study and is reported in Chapters 3 and 5. A more recent RCT has examined the effect of stabilizing exercises and acupuncture on postpartum sacroiliac pain. Women in the experimental group received the stabilising exercises and acupuncture treatment. Control group only received acupuncture treatment; the interventions were administered and taken three times a week and continued for eight weeks. It was determined that both groups experienced the decreased pain intensity and the improved functional disability. Postpartum women who received combined exercise and acupuncture reported more reduced pain levels than those who received acupuncture only. However, it is not clear from this study which type, or combination of exercise was the most effective in reducing the pain (Embaby et al., 2016).

Specific non RCT studies have also examined the effectiveness of exercise on LPP. Nilsson-Wikmar et al. (2005), compared three different physical therapy treatments with pelvic girdle pain during pregnancy at three, six and 12 months postpartum. There was no significant difference among these three groups during pregnancy or at the postpartum follow-ups regarding pain and activity. However, the study established that the pain decreased, whereas activity ability increased between gestation week 38 and at 12 months postpartum. An experimental study by Lavanya (2017), used a multifidus activation exercises programme for postpartum to understand the effectiveness of exercise of postnatal low back pain. A total of 10 women undertook the multifidus activation exercises programme for two weeks. The re-

sults of the study established that multifidus activation exercise could impact and significantly reduce the low back pain on postpartum.

Gustafsson and Nilsson-Wikmar (2008), used a single-subject research design. In this case, 10 postpartum women received a specific deep muscle training of the transversus abdominus and multifidus muscles for 12 weeks. It was ascertained that 10 subjects who completed the exercise programme had significantly reduced postpartum back pain. Although there are several studies investigating the effect of exercise on pain intensity, there is little evidence as to which exercise instructions are most effective and acceptable to postpartum women.

2.2 Exercise among women

Due to the level of economic development, different cultural background, social progress as well as welfare system, women's awareness of the value of physical exercise is not the same in all the women globally (Li et al., 2004). In the following sections, the factors that hinder or facilitate women to exercise and cultural variations in exercise activity among women will be considered.

2.2.1 Barriers to exercise among women

The involvements of women in physical activity are restricted by many factors (WHO, 2017). The first reason is always economic. The earnings of women are very often less than that of men. Thus, the fees for the access to a gym and other facilities of physical activity might be an obstacle (Sternfeld et al., 1999; WHO, 2017). When a female in a family wants more physical activities in facilities, a permission that she is able to go to a gym might be necessary from a senior family member who is in control of the possessions of the whole family, especially for the financial resource (WHO, 2017). In addition to the economic reason, the role a

woman plays in a family usually is a restriction to regularly physical activities. Generally speaking, female members in the families have a large amount of work back at home no matter what work they have outside the family. For example, a mother has to take the responsibility of and care-giving for other people in the family when she is backing home. As a result, she probably does not have spare time to do more exercise (Ainsworth and Macera, 2012).

Moreover, women usually do not have high mobility access, such as cars, like their counterparts in families, thus, they probably have to rely on their male partners to go to a gym and other physical activity facilities (Ainsworth and Macera, 2012; WHO, 2017). In general, the reasons for the low motivation to exercise among women were lack of time, feeling too tired or lacking energy, poor health, lacking a safe space to exercise, having children, working long hours, low social support and environmental barriers (Sternfeld et al., 1999; King et al., 2000; Popham and Mitchell, 2006; Hunter et al., 2014; Janssen et al., 2014; Kosma et al., 2016; Huang et al., 2016).

2.2.2 Cultural variations in exercise activity among women

There is a great amount of variation across cultures and countries in the level of physical activity among women which has been explained to some extent based on various theoretical models. In the USA, non-Hispanic White women had a higher level of physical activity in contrast to Asian Americans and Hispanics, while African American women have reported the lowest level of exercise (Lee and Im, 2010). Another cross-sectional survey of physical activity of women in the USA showed that White women undertook more physical activity than Hispanic, American Indian- Alaskan Native and Black women (King et al., 2000).

Janssen et al. (2014), used longitudinal epidemiological data to understand the maintenance of physical activity in African–American and Caucasian women in Chicago for 15 years. This longitudinal study found that those women with higher autonomous motivation and higher self-efficacy were more likely to be consistently physically active than others (Janssen et al., 2014). An additional study into the daily lives of African American women indicated that the exercises should be planned or comprises a programme with convenient activities, as it could encourage women's ability to improve in exercise motivation (Nies et al., 1999).

In the UK, research on the physical activity of the general population reported that Europeans are more physically active than Indians, Pakistanis or Bangladeshis, and that habitual physical activity was lower in South Asians, specifically among women and older people (Hayes et al., 2002; Fischbacher et al., 2004; Williams et al., 2011). The European Commission Sports Unit reported that most physical inactivity takes place in Italy, Germany and Denmark (Kornbeck, 2013). A survey by the International Physical Activity Questionnaire (IPAQ) compared the physical activity between Poland and fifteen European countries. It indicated that during the 7 days observation period, the Polish demonstrated no vigorous physical activity, whereas it was noted that the Spaniards and Italians did the lowest amount of physical activity in the other European countries. The Dutch had the highest rate of physical activity (Piątkowska, 2012).

In the East Asian area, Chen and Lin (2016), examined the association of factors with physical inactivity among China, Taiwan and South Korea. This study determined that the South Koreans and Taiwanese are more physically active than the Chinese. Additionally, the Hong Kong Student Obesity Surveillance (HKSOS) project investigated the prevalence of physical activity in Chinese adolescents. The authors found that in structured and planned physical

activities; boys were more active than girls (Mak et al., 2011). In Taiwan, Yen and colleague examined the current situation related to the motivations, constraints and lifestyle adjustments in terms of urban women's participation in leisure sports. A total of 373 women finished questionnaires. Results revealed that motivating women to participate in sport and health clubs had a significant and positive affect on lifestyle. The authors stressed that Taiwanese women, motivated to participate in leisure sports, were the strongest antecedent variables influencing lifestyle adjustments, and suggested women should be encouraged to participate in sport and health clubs to assist them to be positive about exercising (Yen et al., 2012). To sum up, the literature has shown that women in different areas and of different ethnicities have dissimilar physical activity levels.

2.3 Exercise during and after pregnancy

2.3.1 Guidelines for women during pregnancy and the postpartum period

In 2003, the American College of Obstetricians and Gynaecologists (ACOG) updated the guidelines and recommended that in the absence of medical or obstetric complications, pregnant women should engage in moderate-intensity exercise for 30 minutes a day (ACOG, 2003). Guidelines for exercise issued in Canada, recommended that pregnant women with healthy, uncomplicated pregnancies can perform aerobic exercise regularly for at least 15 minutes, 3 days per week. The guidelines also recommended that postpartum women without any complications should resume mild activities immediately such as walking, pelvic floor exercises and moderate stretching (Wolfe and Davies, 2003). In 2008, the US government released physical activity guidelines for Americans, including recommending specifically for pregnant and postpartum women that they attain at least 150 minutes (2.5 hours) of moderate intensity aerobic activity per week if performing activities with vigorous intensity.

In 2006, the Royal College of Obstetricians and Gynaecologists (RCOG) advised that all women should be encouraged to participate in aerobic, strength and conditioning as part of a healthy lifestyle during their pregnancy. Specifically, the guidelines cautioned that the aerobic exercise programme should be performed in 15-minute bursts three times a week, increasing gradually to 30-minute sessions four times a week to daily (Bell and Dooley, 2006). Additionally, the Royal College of Obstetricians and Gynaecologists (RCOG) recommend that pregnant women should take moderate physical activity of approximately 150 minutes per week. Furthermore, the guidelines recommend that women without physical problems and obstetric complications should maintain regular exercise during pregnancy and the postpartum period (RCOG 2017).

2.3.2 Exercise benefits among pregnant and postpartum women

Exercise during pregnancy and postpartum is a beneficial and recommended activity for alleviating negative physical and psychological symptoms. Exercise offers potential benefits for women during pregnancy. For instance, exercise in pregnancy is indicated to be useful for the following: 1) maintaining a healthy body weight and avoiding excess fat accumulation; 2) maintaining or improving cardiovascular fitness and muscular strength; 3) decreasing musculoskeletal complaints such as back pain; 4) decreasing minor discomforts related to pregnancy; 5) improving posture and body mechanics; 6) improving general health and psychological well-being; 7) preventing and treating problems associated with gestational diabetes, hypertension and pre-eclampsia (Hammer et al., 2000; Wadsworth, 2007; Haakstad et al., 2009; Melzer et al., 2010; Prather et al., 2012). Further, the benefits of postpartum exercise include: 1) preventing obesity or being overweight via reduction of body fat or body weight loss, 2) promoting aerobic fitness and strength, leading to an improved ability to perform

activities of mothering, 3) optimising bone health by increasing bone mineral density and or attenuating lactation-associated bone loss, 4) improving mood or self-esteem, 5) promoting regular, lifelong exercise habits in the mother and the child (Larson-Meyer, 2003). Ko et al. (2008) explored the effectiveness of an exercise programme on reducing levels of fatigue and depression among postpartum women. In their study, 61 participants were divided into an intervention group (31) and a control group (30). The intervention group was asked to finish six sessions in three weeks, whereas the control group followed a traditional, non-physically active postpartum care regimen. Results displayed statistically significant differences between the two groups in terms of fatigue levels, with statistical improvements ($p < .05$) registered by the intervention group, in terms of levels of physical and psychological fatigue symptoms (Ko et al., 2008).

As stated in Section 2.1.6, exercise interventions have also found to be helpful in alleviating low back and pelvic pain in pregnant women.

2.3.3 Exercise barriers among pregnant and postpartum women

Changes in the women's physical and behavioural state during pregnancy (Hausenblas et al., 2008a), may lead to low motivation to exercise during pregnancy. It has been noted by researchers that most women reduced or did not participate in physical activities or exercises during pregnancy (Clarke et al., 2005; Borodulin et al., 2009; Hausenblas et al., 2011). Some women tend to believe that exercising during pregnancy could harm the baby and induce a miscarriage or preterm labour (Hausenblas et al., 2011). Additional barriers to physical activity among pregnant women may include lack of energy and nausea, especially in the earlier stages of pregnancy (Hausenblas et al., 2011; Groth and Morrison-Beedy, 2013) tiredness, feeling unwell, being too busy and, in late pregnancy, exercise being uncomfortable (Dun-

combe et al., 2009). Furthermore, some women perceive that activity would decrease energy levels during their pregnancy (Melton et al., 2013).

A study undertaken by Evenson et al. (2009a), using a combined qualitative and quantitative approach to identify barriers to physical activity among 1,535 pregnant women, observed that approximately 85% of the total number reported an intrapersonal barrier to physical activity and 52.1% reported a health-related barrier to physical activity during pregnancy. This is in addition to being tired or reporting lower energy, lack of sleep, shortness of breath, musculoskeletal problems and concern with pregnancy complications. Non-health related intrapersonal barriers (32.7%) reported include low motivation, not enough time, lack of enjoyment of being physically active, lack of child care, costs and lack of knowledge concerning activity (Evenson et al., 2009a). Conversely, body changes could affect physical activity both early and late in the pregnancy and they could act as barriers to physical activity. Reasons for not performing regular exercise in the third trimester include pregnancy complaints (28.1%), insufficient time (11.3%), too much effort to get started (10.3%) and difficulties due to children and childcare (9.6%) (Haakstad et al., 2009).

A qualitative study showed that pregnant women found the discomfort and complications associated with pregnancy, the growing body and a sense of insecurity as barriers to maintaining former levels of physical activity (Hegaard et al., 2010). Such barriers among pregnant women ascribed to the effects of pregnancy and changes in the body are also reported in other studies (Clarke et al., 2005). The reasons that postpartum women did not resume exercise include many factors, such as intrapersonal factors (e.g. tiredness, low energy, low motivation and low exercise tolerance), interpersonal factors (e.g. lack of partner support), socio-cultural factors (e.g. lack of support from family, friends) and healthcare environment

factors (e.g. lack of information, advice or encouragement) (Jenkins et al., 2006; Pereira et al., 2007; Evenson et al., 2009b; Cramp and Bray, 2011).

Increases in physical activity following child birth have also been reported. For instance, a cohort study by Borodulin et al. (2009), demonstrated that a third of women at three months postpartum had increased their physical activity, and that this number remained stable at 12 months postpartum. In the postpartum period, the most frequent physical activity performed was relating to caregiving and household chores. Similarly, most vigorous physical activity did not return to type prior to pregnancy levels, and moreover, only less vigorous activities, such as walking, and home activities returned (Pereira et al., 2007; Treuth et al., 2005).

2.3.4 Exercise beliefs among pregnant and postpartum women

Studies on pregnant women's beliefs on exercise illustrated that many women believe that exercise has a positive impact on their health. Hammer et al. (2000), employed a survey to understand the demographic and health-related factors of women who were exercising and not exercising in late pregnancy. More than half of the women believed that performing regular exercise would improve the feeling of well-being and be important in reducing pregnancy complaints. They also believed that regular exercise could prevent excessive weight gain in pregnancy.

Clarke and Gross (2004), examined fifty-seven low-risk pregnancies concerning women's recreational activity patterns and explored pregnant women's beliefs and information sources regarding physical exercise participation. 39% of women performed weekly exercise before pregnancy. Rest and relaxation were perceived as being significantly more important during pregnancy than regular exercise or the maintenance of an active lifestyle (Clarke and Gross,

2004). Duncombe et al. (2009), used an Exercise Safety Beliefs Questionnaire to examine pregnant women's beliefs about the safety of exercise. Most participants believed that low intensity exercise and low impact exercise were safe and that vigorous exercise to the point of losing breath and high impact exercise were unsafe (Duncombe et al., 2009).

Pregnant women believed that positive things that can encourage pregnant women to exercise, include exercise becoming easier, convenience and more social support from family or healthcare professionals (Hausenblas et al., 2011). Evenson and Bradley (2010), established that the responses to beliefs about physical activity and exercise during pregnancy were most often distinguished by race/ethnicity, education, and whether they participated in regular exercise during pregnancy. In this study, 78% agreed that most women can continue to exercise during pregnancy and 89% agreed that regular exercise was better than irregular exercise during pregnancy (Evenson and Bradley, 2010).

In the U.K., Clarke and Gross (2004), reported that 80% of women 'generally enjoyed physical activity prior to pregnancy', whereas 63% of women reported 'engaging in some form of formal sport or exercise activity before becoming pregnant'. A further study reported on the reasons women who are pregnant in the third trimester decided to exercise or not to exercise. The results revealed that 11% participated in regular exercise during the third trimester. The reasons for performing regular exercise were prevention of health complaints and increasing physical fitness, well-being and happiness (Haakstad et al., 2009).

In contrast, postpartum women who exercise believe that exercise can control body weight, help to stay fit and improve overall mood. What appeared to influence their exercise beliefs the most were time limits, physical limitations or restrictions, and tiredness or fatigue (Downs and Hausenblas, 2004). In the qualitative research investigating exercise beliefs for

ten postnatal women, the non-resumes (stop exercise) believed that their time belonged to their baby and their partner, and very rarely prioritised exercise time for them; All of the resumes had a strong sense of entitlement and desire to exercise and attempted to try and have exercise as a priority (Jenkins et al., 2006). Additionally, the most common beliefs in relation to exercise during pregnancy were that exercise improves mood and furthermore, that physical limitations obstructed exercise participation. The most common exercise beliefs during postpartum were that exercise controls weight gain and a lack of time obstructed exercise participation (Downs and Hausenblas, 2004).

Moreover, the women described that being physically active gave them more pleasure, well-being, energy and light-heartedness (Hegaard et al., 2010). Consequently, women who continue to exercise during pregnancy and postnatal feel confident that it not only improved physical activity but also contributed to a healthy life both physically and mentally. Importantly, however, the acceptability of exercise varies among pregnant and postpartum women including their motivation, beliefs, and the perceived benefits, and could be associated with various factors such as previous exercise routine, preparing for pregnancy and lifestyle changes (Hinton and Olson, 2001; Lof and Forsum, 2009). Women who had high self-efficacy of exercise before pregnancy will be more willing to exercise during pregnancy. Similarly, women who have regular exercise habits in pre-pregnancy were able to maintain exercise during pregnancy (Hinton and Olson, 2001; Fell et al., 2009).

Health care professionals also tend to believe that exercise during pregnancy is beneficial. One study with 93 practising healthcare providers (Bauer et al., 2010) showed that 99% of respondents believed that exercise during pregnancy is beneficial and that 90% of healthcare providers recommend exercise to pregnant women. Furthermore, 89% believed that seden-

tary women with uncomplicated pregnancies can safely begin an exercise programme, 97% believed chronic exercisers should be encouraged to continue exercising throughout pregnancy and 76% believed that women should participate in strength-training programmes during pregnancy.

2.3.5 Traditional post-partum practices among Taiwanese women

The culture in Taiwan influences attitudes about engaging in physical activity and the types of activity chosen. In general, traditional Chinese culture emphasises the role of food in health more than physical activity (Ma et al., 2010). In 2015, the Statistical Yearbook of Health Promotion reported on Taiwanese people who exercise regularly. The Yearbook reported that 29.9% of women regularly undertake exercise including wide range age groups from 13 to 70 and above (MOHW, 2015). The Ministry of Health and Welfare (MOHW) (2013), undertook a survey on Taiwanese women undertaking exercise. The results reported that 59% of women had performed ten minutes continuous exercise (running, dancing and walking) in the past month, and 59.35% of childbearing women (aged 18 to 39) had exercise behaviours in the past month. Most of the people involved believed exercise can improve health and fitness. The most popular form of exercise was taking a walk. The barriers to exercise comprised too busy at work, dislike of exercise and lack of opportunity (Peng, 2006; MOHW, 2015).

In many cultures, postpartum rituals are observed because they are believed to have beneficial mental health effects. According to traditional Chinese custom, women should be confined to home and assisted with tasks for one month after giving birth to a child. Many Taiwanese new mothers will reduce their physical activity after birth, a tradition that is well embedded in Taiwanese culture and is known as ‘doing the month’. This is suggested as a

way of protecting bone and muscles (Holroyd et al., 2005; Tung, 2010). Chinese postpartum rituals involve physical and social prescriptions and taboos that a woman has to follow for about thirty days. In the doing the month period, mothers are advised to rest completely, and confined to the home, stay in bed, avoid bathing or washing hair to prevent contact with cold air, wind, and water (Cheung, 1997; Chien et al., 2006). As women are supported to be inactive, a restricted period of stay in a room may increase incidents of postpartum depression and Vitamin D deficiency (Strand et al., 2009; Liu et al., 2014).

Chien et al. (2006), investigated adherence to doing-the-month practices and association between adherence to doing-the-month practices and physical symptoms and depression among postpartum women in Taiwan. The study discovered that the 202 participants reported that most of the physical symptoms at four weeks postpartum were backache and poor-quality sleep or insomnia. Overall, adherence to doing-the-month practices was associated with lower severity of physical symptoms and lower odds of postnatal depression. Adherence to doing-the-month practices was associated with better health status among postpartum women in Taiwan. Yeh et al. (2014), interviewed 27 women at a postpartum nursing centre to explore the traditional Chinese postpartum ritual of doing the month and suggested that doing the month practices may still be widely observed in Taiwanese society.

Ko et al. (2008) used a low-intensity exercise programme in Taiwan which included pilates and yoga movements to investigate the effect of exercise on fatigue and depression on postpartum women during the 'doing the month' period. The findings show that undertaking exercise can help women to reduce psychological fatigue and fatigue symptoms. Thus, traditional practices may influence postpartum women to perform less physical activity in the Taiwanese culture.

However, current scientific knowledge and social changes have influenced the traditional ritual practices of 'doing the month', including the dietary restrictions, hygiene practices, physical activities, and other social prescriptions (Yeh et al., 2014).

2.4 Use of print and electronic media for conveying health information

Leaflets have been used as traditional education material in hospitals. Over the years, health care workers have used leaflets to assist patients to understand their treatments, illnesses and self-care (Coulter, 1998) and as a source of reference for patients after a medical consultation (Kenny et al., 1998). It should be stated that a leaflet enables a patient to read and attempt to understand the content at a more suitable time and furthermore, can be employed to assist people to recognise their health beliefs (Roberts et al., 2002). Similarly, one advantage of a leaflet is that it can be read, is simple to use, and it makes sharing information with family straightforward. In general, patient information leaflets can improve patient adherence to treatment and lifestyle advice (Sustersic et al., 2017). Nonetheless, leaflets can easily be misplaced and lost (Lowry, 1995).

In recent years, as information and communication technology have begun to play a more significant role in the delivery of healthcare, health information can be disseminated to people via a variety of formats, such as email, websites, on interactive digital TV, text messages and video downloads (Colledge et al., 2008). Moreover, technology is being increasingly used in health care (Kumar, 2011). In the U.S., the Centre for Disease Control and Prevention (CDC) has applied social media in health communication campaigns, activities and emergency response efforts. Social media tools, including the use of Facebook, YouTube, Twitter and other such tools which disseminate health messages, have increased significantly and con-

tinue to increase. Beneficial effects include 'the timely dissemination and potential impact of health and safety information; empowering people to make safer and healthier decisions; leveraging audience networks to facilitate information sharing; expanding the reach to include extensive, more diverse audiences; personalising and reinforcing health messages that can be more easily tailored or be targeted at particular audiences; and finally, facilitating interactive communication, connection and public engagement' (CDC, 2011).

Moreover, social media is a powerful tool, which offers collaboration between users and is a social interaction mechanism for a range of individuals. With regards to the practice of using health communication, social media may represent an excellent opportunity to reach traditionally underserved members of the population (Moorhead et al., 2013). Moreover, social networking websites, such as Facebook has been shown to assist with the delivery of public health intervention programmes (Chou et al., 2009).

The world's population currently numbers approximately 7.6 billion people, of which 4.1 billion people are internet users (Internet World Stats, 2018). Men and women use social media differently: women are more likely to use social media for relationships to keep in touch with family and friends, blogging and photo uploading/sharing, entertainment, and how women utilise media related to obtain information related to self-help (Piombino, 2014). Recent advances in technology provide the opportunity to use friendly and potentially interactive modes of communication in health promotion interventions. Interactive media interventions are most often computer-delivered (via the internet or CD-ROM). The benefits of interactive media interventions include incorporation of rich media, immediate and frequently tailored feedback, greater participant action and control, flexibility to participate in a pro-

gramme at the participant's convenience and the potential for wide programme reach (Mauriello et al., 2007).

In Asia, 2.02 billion people use the Internet (Internet World Stats, 2018). In Taiwan, Internet use has grown, and the proportion of the population who are Internet users has exceeded 75%. Some 80% of all homes in Taiwan own PCs and roughly 84% of homes have Internet connection. Most time is spent online searching or collecting information, which represents 57.2% of time spent online by Taiwanese internet users (Peter, 2013). In addition, approximately 64.8% of females are internet users. It is also worth noting that the Internet has created a new opportunity to distribute interventions in a cost-effective manner (Spittaels et al., 2007).

Ritterband et al. (2009), explored a behaviour change model related to Internet intervention of behaviour changes and symptom improvement produced. The model purports that the results supported the user effect on support and website characteristics and were influenced by environmental factors, affects website use and adherence. Website use leads to behaviour change and symptom improvement through various mechanisms of change. The improvements are sustained via treatment maintenance (Ritterband et al., 2009). Moreover, Internet-supported interventions are improving services while exploiting new technologies and bringing about changes in people's expectations and habits (Barak et al., 2009).

It is also worth mentioning that more and more people are using internet search information to solve questions and obtain answers. In addition, healthcare researchers are employing social media such as the internet, YouTube and Twitter to improve human healthcare knowledge, as this medium not only helps people to receive information but is also rapid and valuable as a tool that can disseminate information.

In the following sections, the literature review will discuss the evidence on the effectiveness of the three modes of exercise instruction: leaflet based, DVD-based, and Internet-based instruction.

2.5. Use of print and electronic media for the delivery of exercise interventions

2.5.1 Exercise interventions delivered by way of leaflets in health care

Leaflets are a traditional tool applied in health care settings and provide patients with valuable information. Oesch et al. (2017), established that self-regulated exercise leaflets improved outcomes on those elderly people who had more adherence, enjoyment and motivation related to exercise in a geriatric inpatient rehabilitation setting. The authors stated that improvements in exercise leaflets are required before they are used with older adults and the effectiveness of self-regulated exercise should be considered alongside, comparing them with other methods applied in RCTs.

Roberts et al. (2002), examined the effectiveness of patient information leaflets on knowledge, attitude, behaviour, and function among 64 patients with acute back pain. The findings revealed that leaflets can improve knowledge of sitting posture and achieve behaviour changes related to lifestyle but not affect the function of lower back pain. The authors concluded that leaflets may change aspects of knowledge and behaviour, although they need to determine the effect of personalising information more in leaflets, on a population with lower back pain.

Rice and Johnson (1984), used Self-Instruction Booklets to examine the effectiveness of exercise behaviours among 130 patients undergoing surgical operations. They determined that patients who received the booklets had more of the exercise behaviours than those patients

who did not receive the booklets. The authors stated that self-instruction booklets can provide information, knowledge and change exercise behaviours.

Takeuchi and Horiuchi (2016), in a randomised controlled trial, investigated the effectiveness of antenatal perineal massage provided on a smartphone website and in a leaflet among 161 primiparous women in Japan. Perineal massage information was provided on the smartphone website for the experiment group, whilst the control group received a traditional leaflet. They discovered that women who had the smartphone website or leaflet had similar results pertaining to continuance rates and childbirth self-efficacy. The authors argued that information disseminated via the website or leaflet may affect the outcomes. Therefore, further study should consider adding no treatment as the usual group to evaluate these materials.

It should be mentioned that leaflets have traditionally been used in health education as a means of conveying information. In health education, leaflets have a potentially useful role to play in meeting the health information needs of the public and health professionals. The design of most of the studies used the leaflet group as a control group or a usual care group. The leaflets are employed as a base model in hospitals and patients receive the health information as routine care.

2.5.2 Exercise interventions delivered by means of videotape or DVD in health care settings

This section will discuss the efficiency and effectiveness of DVDs or videotapes as exercise instruction media for all conditions. In a critical review of the literature, Kingston et al. (2010), evaluated the evidence on the use of videotapes or DVDs to promote patient com-

pliance with home programmes. The authors reviewed eleven studies which used videos or DVDs to assess promoting patient compliance with home exercise or health programmes. Each of the studies reported positive compliance concerning provision of a video or DVD pertaining to home exercise. The authors concluded that the use of a DVD or videotape can improve patient compliance with home exercise or health programmes in general health care.

Roddey et al. (2002), compared the effectiveness of two types of home exercise programme instruction, via videotape intervention and personal physiotherapy instruction, to compare the subjective outcomes and exercise compliance. The results demonstrated that there were no differences in the self-reported outcomes of function between groups. Furthermore, the authors suggested that videotapes are a vital patient education tool during rehabilitation (Roddey et al., 2002). Schoo et al. (2005), explored different modes of instruction for exercise performance and compliance with a home exercise programme for older adults with osteoarthritis. The participants were randomly allocated into three groups (brochure; brochure and audiotape; brochure and videotape). After eight weeks' intervention, correctly performed exercises during the first and third assessments were significantly lower for the brochure group than the videotape and audiotape groups. Overall, with respect to compliance with home exercise, no significant difference was discovered between groups which utilised the audiotapes, videotapes or brochures. The authors concluded that audiotapes and videotapes may enhance adherence of home exercise and adding a daily record may remind people to establish an exercise routine. However, more research is required to evaluate those interventions through RCTs.

Petty et al. (2006), compared the effects of exercise delivered through different mediums on quality of life and activities of daily living with chronic obstructive pulmonary disease pa-

tients. Three randomised parallel groups consisting of a personalised videotape group, a standard education video-tape group and a usual care group were formed. It was reported that the personalised videotape group had greater conversion and retention of exercise habits. Increased quality of life and lower fatigue were also ascertained along with improved compliance with a prescribed exercise regimen among subjects using the customised videotapes.

Albert et al. (2007), employed the short-term impact of video education and standard education for 112 heart failure patients to compare healthcare utilisation and adherence to self-care behaviours. The video education developed self-care behaviours and self-management actions that included a treatment plan overview, nutrition, in addition to exercise training and lifestyle. During a three-month follow-up, video education patients exhibited significantly higher self-care behaviour scores and the video intervention improved adherence to self-care.

Vickers et al. (2011), assessed the impact of exercise education intervention on exercise frequency and attitudes in cardiovascular outpatients. A total of 509 participants were randomised to the DVD exercise intervention group and the standard care control group. The DVD lasted about 43 minutes and the content comprised basic information regarding the benefits of exercise and encouraged use of goal setting and other cognitive, behavioural and motivation-enhancing techniques.

Khalil et al. (2012), studied 15 patients with Huntington's disease regarding adherence to exercise, using a home-based exercise DVD. Each participant was required to use the DVD to follow the exercise programme for eight weeks and record adherence and frequency of completion of the prescribed exercises. Eleven of the fifteen participants used the DVD to

perform the exercises and completed five sessions of exercises three times a week. Only four participants reported fewer than 50% adherence. The barriers to use of the exercise DVD were related to physical and cognitive problems due to limitations caused by Huntington's disease. The study established that the DVD was perceived to be suitable and supportive. Additionally, the authors found that the DVD could be appropriate for use in supporting people with Huntington's disease to engage in exercise at home, during therapy or following its completion (Khalil et al., 2012).

Mahler et al. (1999), used two experimental videotapes with different educational approaches to evaluate the effects on compliance with recommended lifestyle changes. In this case, 216 participants were randomised into one of the two videotapes groups prior to discharge from hospital or received only the standard discharge preparation provided by the hospital. The two videotapes contained different content: 'one of the videotapes outlined a representation of mastery portrayal where setbacks are de-emphasised, and recovery is observed as a steady progression forward. The other videotape outlined coping strategies which focused on potential problems'. After interventions, the outcomes for exercise compliance revealed that those with the coping tape reported significantly higher exercise rates at one month and significantly more strenuous exercise at three months, in comparison to those with the mastery tape or the control group. The diet compliance results confirmed that both groups had significantly lower cholesterol and saturated fat consumption scores at one month but not at three months, compared to the no tape group. Patients who viewed the videotapes exhibited greater dietary and exercise compliance than controls during the initial recovery months (Mahler et al., 1999).

Kingston et al. (2014) undertook a study evaluating the features of a home exercise DVD. The participants were randomly assigned to two groups. The control group received brochures, while the experimental group were provided with exercise instructions on DVD and brochures. While not showing significantly different results between the two groups, a prominent finding of the study is the significance of the patient–therapist relationship to ensure the completion and correct execution of a home exercise programme.

McAuley et al. (2013), used a DVD-delivered exercise programme to improve physical activity in older adults. The DVD exercise involved a six-month intervention. The outcome measurements included the Short Physical Performance Battery, assessments of flexibility and strength, and self-reported functional limitations. Here, 307 participants were randomised to the DVD exercise group and the control group. Subsequently, 260 participants were retained at 6 months. After the months follow-up, it was determined that the DVD exercise group demonstrated significant results in the short physical performance battery, besides lower extremity flexibility and upper body strength (McAuley et al., 2013). In addition, Wójcicki et al. (2014), used a similar DVD-delivered exercise programme in a randomised controlled pilot trial to test functional performance and quality of life in older adults with multiple sclerosis. The authors stressed the need for more research to investigate the effectiveness of the DVD-delivered exercise programme in relation to different health problems or diseases in the older adult population (Wójcicki et al., 2014).

Moran et al. (2015), conducted a pilot study on exercise adherence among older people who had previously fractured their hips, with the aim of investigating the feasibility of providing a home exercise programme by way of a personalised DVD. The intervention consisted of a structured five-week home exercise programme delivered using a 30-minute DVD. Each of

the participants identified increased self-efficacy pertaining to exercise and moreover, an increase in activity levels in the weeks following the study. Additionally, adherence was determined to be enhanced by physical improvement.

Katrancha et al. (2015), undertook a pilot study to evaluate video-guided T'ai Chi group intervention on centre of balance and falls efficacy. The T'ai Chi video was designed to include three exercise sessions. Seventeen participants completed the 12-week intervention. Outcome measures were centre of balance and fear of falling. Findings indicated the potential benefits of T'ai Chi in improving the centre of balance among community-dwelling older adults. Tuohy et al. (2015), developed an educational DVD on the use of hand massage in the care of people with dementia. The DVD programme included background, benefits, special considerations, general principles, assessment, and the skills and evaluation related to hand massage. The educational DVD is a learning resource for health care professionals and members of the public. This DVD used technology to support individuals, nurses, carers and families living with dementia.

Rasmussen et al. (2013), used DVD guidance to evaluate the accuracy of home exercise performance by caregivers of children with neonatal brachial plexus palsy. Caregivers received the home exercise DVD programme and an initial demonstration of correct hand placement and movement patterns. This study demonstrated that DVD-assisted home exercises improved caregiver compliance and confidence, as well as the frequency and duration of exercise performed, and DVD use assisted in maintaining correct performance with respect to the exercises. Chan et al. (2013), evaluated the feasibility and effectiveness of exercise DVD programmes on musculoskeletal disorders patients. A total of 144 participants received the exercise DVD programme over 12 weeks and were instructed to perform at least two 40-

minute sessions of exercise per week. A 41% compliance rate was reported for the fifty participants who completed the DVD exercise programmes over the 12 weeks and 78% of participants rated the use of the DVD as good or excellent.

Janda et al. (2002), used breast self-examination educational videotaped intervention to compare women in relation to actual breast self-examination behaviour. In this case, 251 women without a history of breast cancer were randomly divided into a video intervention group and a non-video comparison group. This study indicated that videotape education on breast self-examination is feasible and effective in enhancing women's compliance with breast self-examination. Women educated by the videotape performed breast self-examination more frequently than women in the non-video group at three months follow-up. Wiese et al. (2005), developed a video to enhance patient understanding of obstructive sleep apnoea and determine attendance compliance. The follow-up attendance compliance rate of patients in the video group was 72.9%. In comparison, only 48.9% complied in the control group. According to the study, the use of video can significantly improve the return rate for the follow-up visit. Similarly, the information video can increase knowledge and decrease anxiety in patients preparing for examination, treatment or surgery. Furthermore, Luck et al. (1999) found that the use of an information video can also improve the patients' understanding of the colonoscopy process and make them feel less anxious prior to the examination. The authors emphasised that using video information is beneficial to patients who also prepare for other surgical and medical procedures. Moreover, they explained that video information could become a significant component of preoperative patient preparation.

Sørlie et al. (2007), tested the efficacy of information intervention upon emotional recovery following coronary artery bypass surgery. Here, 109 patients were randomised to the intervention or the control group. The intervention group received video information that comprised an individualised information session, whereas the control group patients received the usual routine hospital pre- and post-operative information and no video. The outcome measured the time from the participants' discharge from hospital over a two-year period. The intervention group were determined to have enhanced emotional well-being and anxiety outcomes. Potter et al. (2014), used a clinical trial to determine the efficacy of a fall-prevention skills DVD training programme for patients with cancer and family caregivers. Participants in the control group received standard fall prevention education, while the treatment group received standard education and a fall-prevention DVD programme to view at home. After three months follow-up, fall risk awareness and fall-prevention knowledge in the treatment group had significantly improved.

With respect to multimedia of interventions in pregnancy or postpartum, Hausenblas et al. (2008b), developed and evaluated a multimedia CD-ROM for exercise during pregnancy and postpartum. The exercise CD-ROM for the intervention was developed by means of using the social cognitive theories of the trans-theoretical model and the theory of planned behaviour. This study aimed to evaluate exercise self-efficacy and knowledge. In this case, 25 pregnant and 25 postpartum women were randomly assigned to either the experimental group or the control group. The experimental group received a PregXerciseTM CD-ROM and the control group received a CD-ROM with neutral content. The results indicated that the experimental group had significant increases in self-efficacy and knowledge.

Jackson et al. (2011), designed a computerised, multimedia Video Doctor tool to deliver targeted counselling messages. The study design was a randomised control trial to compare a video doctor intervention with the usual care concerning nutrition, exercise and weight gain during pregnancy. With 158 participants in the video doctor group and 163 participants in the usual care group, results demonstrated a statistically significant increase from the baseline in the intervention group pertaining to the exercise. The authors supported the view that a brief video doctor intervention can improve exercise and dietary behaviours in pregnant women.

Additionally, a systematic review paper reported the use of technology-supported lifestyle interventions for healthy pregnant women and their impact on maternal outcomes. The findings of the systematic review indicate that communication technology holds the potential to be a safe and sustainable therapeutic tool for the support of lifestyle interventions in pregnancy (O'Brien et al., 2014). However, only one study used a videotape as an instruction for postpartum women with LPP. This was a RCT study performed by Mens et al. (2000). In this study, the authors used a 30-minute videotape to explain the possible cause of pelvic pain, prognosis, and therapeutic possibilities for all participants. The authors believe that individual instruction via videotape can improve the dissemination of information.

By way of the videotape and DVD as an instruction used in clinical care, the videos were successful at providing information and self-care education in different diseases. Literature reviews have provided that video via videotape or DVD instructions improving disease knowledge and health self-care on patients. The review of the literature found that most studies on exercise for the chronic disease population presented the exercise interventions as a DVD or videotape (Luck et al., 1999; Mahler et al., 1999; Janda et al., 2002; Petty et al.,

2006; Albert et al., 2007; Sørlie et al., 2007; Khalil et al., 2012; McAuley et al., 2013; Chan et al., 2013; Wójcicki et al., 2014; Moran et al.,2015). Overall, the evidence reveals that instruction via videotape or DVD can be used in healthcare settings as an education tool to improve patient's self-care and knowledge.

2.5.3 Exercise interventions delivered through the Internet in health care

This section discusses the literature on the use and effectiveness of internet as a medium for the delivery of health care interventions. McKay et al. (2001), evaluated an eight-week pilot study on the use of an Internet-based intervention to assess the physical activities of diabetes patients. In their research, 78 patients were randomly assigned to the diabetes network active lives physical activities intervention or to an Internet information-only group. The experimental group received a tailored personal physical activity programme and was assessed online for physical activity levels. Moreover, internal analysis revealed a significant relationship between extent of website use and level of improvement in physical activities. The authors concluded that internet-based interventions appeared to be effective in increasing activity levels among those patients who use the service with sufficient regularity.

Spittaels et al. (2007), evaluated a website delivered, computer-tailored intervention for increasing physical activity in the general population. Specifically, 434 participants were allocated into three groups. Intervention group one received tailored physical activity advice and e-mails to visit a specific section on a website. Intervention group two only received tailored physical activity advice. No intervention information was given to the control group. The results for both intervention groups demonstrated considerably more time for physical activities compared to the control group. A website delivered intervention, including com-

puter tailoring, increased physical activity when compared to the no-intervention control group.

Motl et al. (2011), conducted a pilot RCT to examine the effect of an Internet intervention based on social cognitive theory to favourably increase physical activity among individuals with multiple sclerosis. In this case, 54 participants were randomly placed into two groups (an Internet intervention condition or a control condition). Follow-up was over a three-month period to collect the physical activity and mediator data. There was a significant result in terms of physical activity over time, with the intervention group displaying a large increase. The effect of the Internet intervention was mediated through a change in goal setting behaviour and was most successful in those who did not initially engage in goal setting behaviour and those who had less severe disability (Motl et al., 2011).

Bossen et al. (2013), developed a web-based intervention to provide a tailored physical activity programme for patients with knee and/or hip osteoarthritis. It was set up to investigate the preliminary effectiveness, feasibility and acceptability of Join2move in patients with knee and/or hip osteoarthritis. Data was collected from twenty participants over twelve weeks. Interviews and usability tests suggested the intervention was feasible and acceptable in promoting physical activity in patients with knee and/or hip osteoarthritis, and participants in the web-based intervention group expressed high satisfaction with the physical activity programme and rated it easy to use.

Van Zutphen et al. (2008), studied 238 pregnant women in their use of a website at home which provided information on a healthy lifestyle programme. The intervention programme was an eHealth programme to support women to have a healthy pregnancy and to provide links to reliable websites to search for additional information. The result of the study con-

firmed that 17% of the target population enrolled in the eHealth programme and 9% of the participants invited continued to use the programme throughout their pregnancies. The low reach using this eHealth programme determined that most of the women were highly educated and already had a healthy lifestyle.

Larsson (2009), investigated pregnant women who use the Internet to retrieve pregnancy-related information. The aim of the study was to understand how often the pregnant women searched the internet and what sort of information they were looking for, and furthermore, how the reliability of the information was perceived. Most participants considered the information to be reliable; 84% of the women used the internet to obtain information, most often in the early stages of pregnancy. In a study on the use of the Internet by Chinese women to seek pregnancy-related information, 91.9% of the women were reported to have access to the Internet; 88.7% of women used the Internet to retrieve health information and they began from the early stages of their pregnancy. The most frequent search topics were foetal development and nutrition in pregnancy. Moreover, more than half of the women believed the information was reliable (Gao et al., 2013).

However, regarding the literature review, most studies investigated chronic disease in patients. There was no evidence of providing the exercise programme via the Internet or website delivered models for postpartum women.

In summary, the review of the literature indicates that exercise programmes can be delivered via different modes of instruction, for instance videotape, DVD, website information, Internet tools, leaflets and booklets to educate patients in healthcare. However, scant evidence exists to support the acceptability and effectiveness of these media in delivering exercise interventions. With the advance of science and technology, the Internet has become a

convenient and important tool for people. Nowadays, many exercise programmes are posted on the internet, such as YouTube, for people to choose and view. Current researchers have through internet or website delivered models to investigate the acceptability of healthcare information on the patients. It is recognised that the leaflet employed to provide information on the exercise programme has been used in postpartum women for many years. In addition, there is no evidence regarding the effectiveness of the leaflet as an exercise programme for postpartum women, and no evidence supports another delivery method, such as the Internet, as an instruction for the exercise programme given to postpartum women. However, investigating the exercise programme using Internet based intervention on postpartum women is a very important issue, given that there is a gap of knowledge in this area. Furthermore, no study has yet been conducted to compare the effectiveness of DVD-based, Internet-based and leaflet-based exercise among postpartum women, especially in Taiwan.

2.6 Theoretical frameworks related to multimedia learning theory

This thesis is informed by the multimedia learning theory model. Before discussing the theory, it is important to understand the concept of 'multimedia learning', which is key to the current study, and how it has been conceptualised over time. Therefore, in this chapter, the development of multimedia learning and an examination of how the concept has been shaped over time are provided. This includes a focus on the definitions of multimedia learning, theoretical and conceptual frameworks.

This chapter also discusses and explains why the multimedia learning theory theoretical model has been adopted in this study.

2.6.1 Development of multimedia learning theory

The theory of multimedia learning is proposed by Richard E. Mayer, who is an American educational psychologist and cognitive psychologist in his book titled 'Multimedia Learning'. Through a large number of psychological experiments, the strength of the theory and scientific basis have been proved. Mayer postulated that multimedia information designed according to psychological learning theory is more likely to consist of meaningful learning than the information not designed in accordance with the psychology of people (Mayer, 2002). Based on this understanding, Mayer studied the cognitive law of multimedia learning. He subsequently proposed the five steps of multimedia learning and the multimedia cognitive model and furthermore, the seven principles of multimedia design based on the two-channel hypothesis, capacity-limited hypothesis and active processing hypothesis. The figure describing the framework of the theory is illustrated in Figure 3.

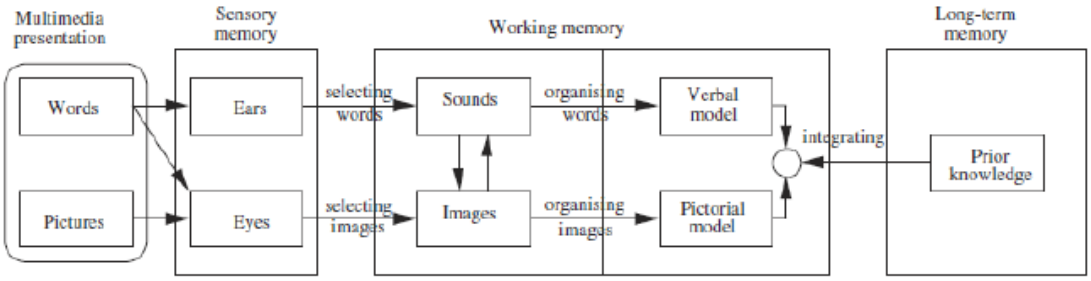


Figure 3: The framework of the cognitive theory of multimedia learning (Mayer, 2010)

As it can be noted in the diagram, the five columns in Figure 3 above signify the knowledge representation—physical representations methods that can be utilised (e.g., words or images that the learner is shown), sensory representations (via the learner's ears or eyes), shallow working memory representations (e.g., sounds or images the learner can hear or see), deep

working memory representations (e.g., verbal and pictorial models created by the learner), in addition to long-term memory representations (e.g., prior knowledge relevant to the learner). The ability to show words and pictures physically, and moreover, the capability to accommodate knowledge in the long-term memory is almost limitless; however, it should be indicated that the ability to retain mentally and manipulate words and images in working memory is inadequate.

In the diagram the arrows signify cognitive processing. The arrow pointing from words to eyes symbolises printed words that impact the learner's eyes; the arrow pointing from words to ears denotes spoken words that impact on the ears; the arrow pointing from pictures to eyes signifies pictures (e.g., illustrations, photos, charts, animations and videos) have an effect on the eyes. The arrow described as selecting words signifies learner's focusing on several of the auditory senses that the ears are able to pick up, while the arrow termed selecting images symbolises learner's concentrating on the visual sensations that are being detected and entering the eyes. The arrow termed organising words shows learner's creating a intelligible verbal representation from the words that are received, whereas the arrow labelled organising images denotes learner's generating an illustrative and clear representation from the images that are being perceived. Finally, the arrow labelled integrating on the right of the diagram, signifies combining the verbal and pictorial model, besides any appropriate prior knowledge. It is also proposed that the selecting and organising processes could possibly be directed in part by prior knowledge that the learner triggers.

In multimedia learning, effective processing necessitates several cognitive processes that can to be utilised. These contain choosing and organising words and images, and furthermore, incorporating and choosing images. In line with the active-processing assumption, these

methods place a number of different demands on the cognitive capacity of the information-processing system. Consequently, it should be noted that the arrows seen in Figure 3 correspond to the active processing required in relation to multimedia learning (Mayer and Moreno, 2003).

2.6.2 What is multimedia learning theoretical sources

In the construction of multimedia learning cognitive theory, Mayer synthesises research results in relation to cognitive psychology. This is also reflected in the theoretical names and theoretical models used in Mayer's articles at various times. For example, the term 'cognitive theory of multimedia learning' first appeared in Mayer, Bove and Tapangco's 1996 article (Mayer et al., 1996). In a book on 'multimedia learning' in 2001, Mayer identified multimedia learning as the theoretical name and multimedia learning is still in use today. In addition to the 'multimedia learning cognitive theory', Mayer has used other names, such as 'model of meaningful learning', 'cognitive conditions for effective illustration' 'dual-coding model', 'dual-processing model of multimedia learning', and 'theory of generative multimedia learning '. The cognitive learning model of multimedia learning was first seen in the article published by Mayer et al. in 2001 (Mayer et al., 2001). Prior to using this theoretical model, Mayer also used two earlier versions of the dual-coding theory model for multimedia learning and the theory of generative learning model for multimedia learning. The theories described below are often cited in Mayer's published articles, which have had an important impact on the development of cognitive theory in multimedia learning in different periods.

2.6.2.1 Assimilation Theory of Learning

In 1978, Ausubel began to use the term Assimilation Theory of Learning to describe epistemic learning, subordinate learning and the parallel combination of meaningful learning process.

Ausubel divides learning into mechanical learning and meaningful learning. Mechanical learning is verbatim, meaning that the learner does not establish a connection between what is known and what needs to be memorised, while meaningful learning refers to the process where the learners associate potentially meaningful information with the learner's known content in a substantive and non-perceivable manner. Ausubel argues that meaning is not something that exists within the text but is external to the learner and that the text material is potentially meaningful. The meaning emerges when the learner takes the initiative to explain their experience by using some sort of inner cognitive operation. There are three necessary conditions for meaningful learning: (1) the learner must take a meaningful learning attitude toward the learning task; (2) the learning material must be potentially meaningful; (3) the learner knows the known knowledge and how it relates to what they want to learn. The advance organizer is the teaching technology based on the theory of assimilation to promote meaningful learning (Driscoll, 2013).

Assimilation theory is an important theoretical basis of Mayer's cognitive theory of multimedia learning. In 1979, Mayer conducted a series of experiments to examine the assertions and criticisms of the advance organizers. As mentioned earlier, Mayer's research on graphic advance organizers is a ground-breaking study of adding images to texts. Assimilation theory distinguishes between meaningful learning and mechanical learning and emphasises the interaction between old and new knowledge. This theory has a significant influence on Mayer's cognitive theory of multimedia learning.

2.6.2.2 Double coding theory

It has been suggested by the double-coding theory that humans have two cognitive systems that are different and independent in function and structure but interrelated in processing

and storing information: ‘speech systems’ and ‘nonverbal systems’ (namely, visual system) (Paivio, 2006). Speech symbols are the storage information units of the speech system and the storage unit of non-speech system is the acquired images. In the terms of the organisation of information, speech information is organized in a continuous form with sequential processing only, while non-verbal information is organized in a synchronized manner, which allows a number of the components of psychological representation to be processed at the same time. There are two main types of processing: fine processing and reorganisation of materials. One way of processing highlights speech association. A word such as ‘free’ can produce many associations that distinguish it from other words. Another method of processing is to produce a visual representation to represent a picture or a word. The abstract - concrete dimension plays a decisive role in shaping the representation. The most specific is the pictures, because the pictures themselves can be directly seen as the appearance for memory without the need for additional generation. Pictures often have better memory effect than that of the specific words, and specific words have a better memory effect than that of abstract words. Using two types of memory encoding to recall an item gives a greater chance of remembering the item than using only one encoding. Learning foreign language vocabulary is a good example of dual coding theory (Reed, 2006).

Mayer adopted the point of view of the dual coding theory that the human information processing system is divided into verbal and non-verbal systems and believes that the human information processing systems have essentially different processing methods for verbal materials and image materials. Since 1991, Mayer has primarily used Allan Paivio's double-coding theory as the basis of his study. In 1994, an early version of the multimedia learning cognitive model, namely, ‘The double-coding theory model of multimedia learning’ was put forward by Mayer and Sims (1994). In the of multimedia learning process, learners need to

go through three cognitive process: (1) to establish verbal representations between external verbal interpretations and internal psychophysical representations; (2) to establish a visual representation relationship between the external visual representation and the visual representation; and (3) to establish a reference link between the internal psychophysical representations and the visual representations. The establishment of reference links is the core of learners' understanding of learning materials.

2.6.2.3 Theory of generative learning

Merlin C. Wittrock's theory of generative learning holds that human learning is a process where learners actively construct new knowledge and generate new meaning, rather than a simple process of acceptance. Learners in the learning process have the following four components: generation, motivation, attention and previous knowledge and experience. Generation refers to the formation of an inherent link within new knowledge and the link between new knowledge and experience. The former is referred as the text linkage, and the latter is referred to as an external link. Generation is the essence and core of generative learning. On the basis of generative learning theory, Wittrock developed a series of generative learning techniques, such as taking notes, including excerpts, annotations, headings, general remarks or a structural syllabus (Wittrock, 1989).

Compared with Ausubel's theory of assimilation, Wittrock's generative learning theory emphasises the generation of learners and reflects the basic idea of contemporary constructivist learning theory. Generation is an important theoretical source of active learning mechanism in Mayer's cognitive theory of multimedia learning. Mayer proposed another early version of multimedia learning theory on the basis of the generative learning theory, namely 'generative theory of multimedia learning' in 1995 (Mayer et al., 1995). Learners in the pro-

cess of multimedia learning should independently complete a sequence of cognitive processing, including the selection (text and image), organization (text and image) and integration.

2.6.2.4 Working memory model

The working memory model proposed by Baddeley and Hitch also holds that there are two information processing channels in the human information processing system (Baddeley and Hitch, 1974). However, unlike the distinction between verbal and nonverbal systems made by the two-coding theory, Baddeley and Hitch argue that an information-processing channel processes material that are presented in the form of visual representations, while the other channel processes the material presented in auditory form. In addition, the working memory model theory emphasises that the working memory capacity is limited. In the working memory model proposed in 1974, working memory consists of three parts: a phonological loop, which is responsible for maintaining and processing auditory information; a visuospatial sketchpad, which is responsible for storing and processing visual and spatial information; central executive, which is responsible for selecting strategies and integrating information. The central executive is also the core of the control of the cognitive resource allocation system (Baddeley and Hitch, 1974). In 2000, Baddeley added a fourth component, the episodic buffer, to the working memory model (Baddeley, 2000). The episodic buffer is a storage system. Different forms of memory coding can be integrated together, such as the virtual images formed in mind according to verbal description. When people listen to a story related to war, they possible can have a virtual image of tanks, attacking planes and guns. The episodic buffer Baddeley introduced is intended as a limited capacity of the memory. The information from the visual spatial template and the information from the speech sys-

tem can be integrated to form the multivariate coding in this buffer. Thus, the three-component working memory model was revised to a four-component model (Baddeley, 2002).

2.6.2.5 Cognitive load theory

Cognitive load theory is also a very influential theory concerning multimedia learning theory. The theory was first proposed by Sweller in the 1980s, and developed rapidly in the 1990s (Sweller, 2005). Cognitive load theory describes the cognitive architecture of the human information processing system and its implications for teaching. Cognitive load refers to the load caused by the information to be processed in working memory. The fundamental belief related to this specific hypothesis is that the working memory capacity is extremely limited (Sweller, 2005). If the total amount of resources that the individual working memory can provide is not enough for the resources required by cognitive processing in the learning process, overload will be the result. Thus, the quality of learning will be affected. Therefore, teaching activities should consider ways to reduce the cognitive load in the learning process. For example, familiar and organised information stored in long-term memory can be used as a substitute for a central executive missing from working memory when new information needs to be processed (Sweller, 2005). Sweller divided the cognitive load into three categories: (1) extraneous cognitive load refers to the inappropriate teaching design caused by the cognitive load, such as teaching materials that have nothing to do with the target; (2) the intrinsic cognitive load refers to the cognitive load that must be processed caused by the complexity of the information itself, such as the number of information components and the degree of interaction amongst them; (3) germane cognitive load refers to cognitive load caused by students working hard to learn (to promote schema construction and automation)

(Sweller, 2005). Among them, the germane cognitive load is an effective cognitive load (Sweller, 2005).

The main characteristic of the cognitive load theory is that it further develops the limited working memory capacity for the teaching. Mayer draws mainly from the cognitive load theory in respect of the limited view of working memory capacity and the classification of cognitive load by Sweller (Mayer, 2005a). He also categorises cognitive processing carried out by the learners in the multimedia learning process on the basis of: (1) extraneous processing, which results in an unrelated cognitive load (similar to an extraneous cognitive load); (2) the essential process, which results in the necessary cognitive load (similar to the intrinsic cognitive load); (3) generative processing, which promotes meaningful learning outcomes (Mayer, 2005a).

Based on the comprehensive research of cognition psychology and based on a large number of experimental evidence, Mayer proposed the cognitive theory of multimedia learning in 2001 and explains how students construct their knowledge from texts and pictures (Mayer, 2008).

2.6.3 Meaning of Multimedia Learning

First of all, Mayer believes that multimedia learning is knowledge construction (Mayer, 2002). Learning is a very complex human phenomenon. In terms of psychological research, for more than 100 years since the birth of scientific psychology, many psychologists have put forward a variety of views, and subsequently formed a large number of schools of learning theory, such as stimulus-response learning theory, cognitive learning theory, humanistic learning theory. Mayer referred to this historical development process and summarised it into three metaphors about learning: the first metaphor is to see learning as a response en-

hancement. The metaphor was formed in the first half of the 20th century, mainly based on laboratory animal studies. The second metaphor considers learning as knowledge acquisition, which was formed between the 1960s and 1970s when psychological research shifted from animal studies in laboratory scenarios to human learning in laboratory scenarios; The third metaphor is to understand learning as knowledge construction, that is to say, when learners try to make their experience meaningful, they are actually constructing their own psychological representation (Mayer, 2002). Mayer regards multimedia learning as knowledge construction and believes that learners are active constructors of meaning in the process of multimedia learning. They are not simply storing the information the multimedia presents into the memory for future needs extraction, but to accept the information multimedia delivers and organize and integrate it into a coherent psychological representation structure themselves.

Secondly, Mayer believes that the essential characteristics of multimedia are both text and picture. Multimedia learning refers to the learner constructing psychological representations from texts and pictures (Mayer, 2005b). However, the text and picture Mayer refers to is different from our daily understanding of the concept of text and picture. Mayer 's text refers to materials presented in a verbal form, which includes not only printed text but also spoken text; a picture refers to material presented in a pictorial form, such as static graphs (e.g. illustrations, diagrams, photos and maps), and dynamic graphics (e.g. animation, video and video clips) (Mayer, 2005b).

There have always been different opinions on what is multimedia, and now multimedia has been used as a synonym for computer multimedia technology for many years. In fact, it is clear that multimedia is a combination of ‘single media’. In defining multimedia learning,

Mayer distinguishes between delivery media, presentation modes and sensory modalities, and takes a holistic view of multimedia definitions from the perspective of facilitating learning. Mayer believes that the transmission medium is the system or equipment used to present the teaching materials. According to the concept of transmission media, multimedia refers to presenting learning materials with the use of more than one delivery device, such as the use of text in the book and on the screen for description, instructions and the interpretation of how the system works together. Presentation mode refers to the way in which learning materials are presented, such as text and images. For example, a multimedia presentation on how the system works can be composed of graphical and textual explanations or narratives and animations. Sensory modality refers to the sensory system used by learners to process information, such as auditory, visual, tactile, and taste.

According to this view of sensory modality, multimedia presentation can enable learners to use a variety of sensory modalities to process information acquired. For example, a multimedia presentation on how the system works can consist of written text and verbal commentary. Early multimedia research was generally based on the concept of transmission media. It was concerned with the different transmission media, such as combinations of projectors and tape recorders and flip charts and film. Researchers who study multimedia learning from the perspective of cognition are now mostly opposed to this view of multimedia, arguing that although this view is exceedingly important in theory, it does not make a fundamental difference to the learner's learning. For example, whether an article is transmitted through a computer screen, a printed book, or whether a picture is displayed on a wall chart or on a projector, there is no essential difference in facilitating understanding (Schnotz, 2005). Mayer does not agree with the media view, either. From Mayer's definition of multimedia learning, it can be seen he defines multimedia mainly from the perspective of presen-

tation mode. However, in the case of text, it can be presented either as a visual form of printed text or as an oral form of auditory form. Hence, Mayer's definition also incorporates the sensory modality. That is why Mayer mentioned more than once that 'what I call multimedia learning can be more precisely called dual-code learning or dual-channel learning' (Mayer, 2002).

2.6.4 Rationale for adopting the multimedia learning theory

The theory of multimedia learning is based on the assumptions that humans possess separate systems for processing pictorial and verbal material. It is termed dual-channel assumption which is limited-capacity assumption and active processing assumption. Limited-capacity assumption is restricted in the amount of material that can be processed at one time, and the active processing assumption in meaningful learning involves cognitive processing including building connections between pictorial and verbal representations. Mayer (1984), asserted that the learner via auditory/verbal and visual/pictorial received information, illustrations, animations, movies, screen text or sound, can increase their attention. Furthermore, information delivery to the learner's brain is processed by means of selecting, organising and integrating. The learner selects words and images from his/her working memory, then organises and processes information by means of verbal short-term memory and visual short-term memory. Finally, the learner integrates information, connecting the organised information as knowledge into memory. In other words, how to use the correct materials is incredibly important for the learner with respect to obtaining knowledge.

2.6.5 Experiences of multimedia learning theory in health education in clinical care and exercise in postpartum women.

Multimedia learning theory has predominantly been applied in education in the field of medicine. Ruiz et al. (2006), believe that multimedia learning is able to enhance knowledge and performance with the utilisation of internet technologies. Additionally, multimedia learning and computer technologies allow learners to be leading characters. They can control what to learn, at what pace and for how many hours per day (Ruiz et al., 2006). Moreover, multimedia learning provides them with chances to customise their learning. Hence, learning can satisfy their personal learning aims (Ruiz et al., 2006). For example, it is beneficial that learners learn the structure of the human body in simulated medical environments (Stull et al., 2009).

Similarly, certain other studies have used multimedia learning for health education in clinical care. For example, Huang et al. (2009), compared two groups with diabetes, learning with or without interactive multimedia. The experimental group received patient education concerning diabetes via interactive multimedia for 3 months, while the control group received routine 3-month patient education. The results reveal that the experimental group demonstrated greater improvement in understanding diabetes than the control group. The use of an interactive multimedia device to intervene in diabetes self-care was effective only in developing the subjects' knowledge in relation to the disease (Huang et al., 2009).

An additional study compared the costs and effectiveness of education on the subject of enterostomy, using a multimedia learning education programme and a conventional education service programme. It was established that the subjects in the multimedia learning education programme group demonstrated significantly better outcomes in the effectiveness of measures of self-care, attitude of self-care and behaviour of self-care. Therefore this re-

search has provided useful information for those who would like to improve the self-care capacity of stoma patients (Lo et al., 2010). In addition, Hung et al. (2011), explored how the multimedia-mediated disclosure of informed consent prior to surgery influences the learning process and learning outcomes of patients. Research has indicated that multimedia-mediated disclosure outperformed other more traditional methods, in that it enhanced learning, interest, remembering, comprehension, and satisfaction. Correspondingly, learning motivation and interest were positively and strongly correlated with perceived comprehension and satisfaction.

Chumley-Jones and colleagues reviewed 76 studies on the utility of web-based learning, drawing on evidence from disciplines such as Medicine, Nursing and Dentistry. In terms of achievements in the knowledge of learners, students in the group of multimedia learning gained as much knowledge as the control group and their quality of learning via Web-based instruction is higher (Chumley-Jones et al., 2002). Moreover, students are more motivated with e-learning (Chumley-Jones et al., 2002). It should be mentioned that Ruiz et al. (2006), agree with the ideas that multimedia learning in the medical education community is effective and acceptable. They also hold that it would be more efficient particularly when multimedia learning is combined with conventional activities led by teachers in a blended-learning educational experience (Ruiz et al., 2006).

Maag (2004), compares and contrasts the effectiveness of an interactive multimedia learning tool with text only, text and images, and multimedia learning explanations and student satisfaction (Maag, 2004). Students in the multimedia learning group scored the same as the control group in maths achievement and maths self-efficacy. The students were more satisfied with the learning tool than that of the control group (Maag, 2004). However, Mayer men-

tions that the application of the cognitive theory of multimedia learning in medical education can be fruitful by improving medical instruction and cognitive theory; nevertheless, it is also a risk, seeing as students might be distracted and require help from teachers (Mayer, 2010). Mayer also suggests that multimedia learning should follow the principles of learning design.

It is commonly believed that the utilisation of multimedia learning theory could promote learning results. To be specific, multimedia learning could assist people gain knowledge of exercise and motivate people to have an active life style. Moreover, multimedia learning could help people gain more exercise knowledge and promote exercise. Ponpaipan et al. (2010), also conducted a survey on the multimedia-based exercise training session in terms of its effectiveness and satisfaction compared with a traditional training programme. After random assignment to experimental and control groups, 63 health volunteers answered a demographic questionnaire, the Exercise Knowledge Questionnaire (EKQ), Efficiency Regarding the Use of the Computer Programme Questionnaire (EUCPQ) and Satisfaction Regarding the Use of the Computer Programme Questionnaire (SUCPQ) (Ponpaipan et al., 2010). Hence, it was observed that exercise knowledge was higher after three weeks. Volunteers were also satisfied with the entire multimedia programme, which therefore indicates that multimedia could be an effective tool to promote exercise.

A multimedia programme can improve the enthusiasm of women to participate during their pregnancy and postpartum, which is thought to be more conducive to the health of mothers and infants. Hausenblas et al. (2008b), developed and evaluated a multimedia-based exercise programme. Postpartum and pregnant women are grouped into an experimental group, receiving a multimedia CD-ROM, and the control groups, receiving contents delivered by a

single medium. Self-efficacy and knowledge were then assessed (Hausenblas et al., 2008b). Hausenblas and colleagues ascertained self-efficacy and knowledge of exercise increased compared to the control group. Additionally, they concluded that multimedia learning could deliver more motivation and guidelines for exercise leading to effective treatment. It is worth noting that it is recommended that healthcare givers can promote exercise in postpartum women with multimedia content (Hausenblas et al., 2008b).

To summarise, the application of multimedia has become more widespread within education. Moreover, multimedia is a developing set of teaching and learning tools that bring together motion video images, graphics, sounds and text in a computer-generated setting, which the user operates. Multimedia instruction is extensively used in healthcare; however, studies report scant evidence on postpartum exercise findings. Research has confirmed that participating in sports can increase healthcare knowledge, health promotion and disease prevention, and that a lack of participation can have a negative effect on motivation. The majority of the studies sampled participants experiencing various diseases, which makes comparisons between them problematic, while fewer studies examined exercise programmes among postpartum women. In addition, using multimedia instructions for exercise programmes during the postpartum period is limited and/or not explicitly explored, and moreover, there is a need for more multimedia exercise programme focused research on the postpartum period.

The phase 2 PRCT study presented as part of this thesis is informed by the multimedia learning theory theoretical model and follows multimedia learning regarding the delivery media view and presentation mode view to design a video comprising a postpartum exercise programme. It employs display screen text, narrative and dynamic pictures as delivery media view. In presentation mode view, the animation is received by the visual sensory receiver,

whilst the sound is received by the auditory sensory receiver. The multimedia learning theory process aligns with the scope of this study, provides a rationale aiming to explore how multimedia learning can initiate learner motivation and improve learner exercise knowledge, and moreover, achieve changes in the exercise behaviour of postpartum women.

Chapter 3

METHODOLOGY – SYSTEMATIC REVIEW ON THE EFFECTIVENESS OF EXERCISE ON LPP AMONG POSTNATAL WOMEN

This chapter discusses the methodology of the systematic review that was conducted in Phase 1 to appraise and synthesise the evidence on the effectiveness of exercise programmes on LLP among postpartum women. Aspects of the systematic review protocol such as the inclusion criteria, quality appraisal procedure and methods of analysis are discussed along with a brief review of the evolution of the systematic review as a research method.

3.1 Introduction

Systematic review is an important method of data collection and evidence evaluation in evidence-based practice. It should be mentioned that evidence-based medicine is the combination of individual clinical expertise in conjunction with the best available clinical evidence obtained from systematic research and patient's values and expectations. Primary care physicians require evidence for both clinical practice and for public health decision making. The evidence is obtained from positive evaluations of current evidence regarding a specific research question. It should be mentioned that reviewing articles has an important role in decision making in evidence-based medical practice. As health professionals are constrained by time systematic reviews and clinical practice guidelines are a valuable source of evidence (Gopalakrishnan and Ganeshkumar, 2013). The database-based systematic review was first proposed by the British epidemiologist Archie Cochrane in 1979 and focused on the efficacy of interventions for prevention and rehabilitation. It is characterised by clear and rigorous

steps that enable researchers to locate, collect, analyse and appraise the quality of evidence on a range of interventions. David Sackett (1996), defined the meaning of review, systematic review and Meta-analysis. A review is the general term for all attempts to produce the results and conclusions of several publications related to a particular topic. An overview is when a review strives to comprehensively identify and track down all the literature on a given topic (also called a "systematic literature review"). Meta-analysis is a specific statistical strategy for assembling the results of several studies into a single estimate.' More specifically, the production process of a systematic review includes: 1) asking questions; 2) developing inclusion and exclusion criteria; 3) a written plan; 4) a literature search; 5) screening literature; 6) evaluation of the risk of bias in studies included in the review; 7) extraction of data; 8) data analysis, qualitative or quantitative analysis (narrative or meta-analysis); 9) discussion and analysis of bias; 10) publication.

When the assessed intervention is updated, or new research methods lead to the emergence of new evidence, the systematic review needs to re-evaluate, update and supplement the new information, according to the above steps. Systematic reviews and meta analyses in studies using RCTs are considered superior in the hierarchy of evidence-based research, while qualitative case studies and expert opinions occupy the lowest rung on this hierarchical ladder (Evans, 2003; Frymark et al., 2009). It should be noted that the RCT is deemed to have strong internal validity (established a statistically significant causal link between intervention and outcome) may have weak external validity (its applicability across settings and populations) when compared to descriptive studies (Evans, 2003; Melnyk, 2004). Inherent in this rating hierarchy is the belief that systematic literature reviews produce the highest level of evidence (LoBiondo and Haber, 2010). The preference to include the so-called high ranking types of studies on the hierarchy of evidence in systematic reviews is evident.

The systematic review methodology has been applied in many fields, it can be applicable in nursing, public health, psychology, supply management and other fields (Hardeman et al., 2002, Thor et al., 2007, Chai et al., 2013). It can also be used to identify the shortcomings of published studies and to recommend areas of future research.

3.2 Evolution of the systematic review as a research method

3.2.1 Addressing the challenge of an ever growing medical literature

Every year, 17,000 biomedical monographs and 30,000 biomedical journals are published with an annual growth rate of approximately 7% (Lowe and Barnett, 1994; Smith, 1991). Physicians and practitioners need to read at least 19 basic pieces of professional literature (journals) to grasp the progress of their discipline (Davidoff et al., 1995). Straus et al. (2005), investigated the time that internal medicine physicians spend reading medical literature in a week and determined that the median spent in reading was no more than 90 minutes. Like-wise, 15% to 40% of the senior resident physicians had not read any medical literature in the week before the survey.

With constantly growing medical literature, it is unrealistic and practically impossible that all medical professionals can be kept informed of all new developments. Systematic reviews can address the aforementioned challenge by providing a comprehensive review of available evidence and summarising outcomes of interventions. A systematic review may or may not include meta-analysis (statistical methods used to extract data from a single study in merger analysis to estimate the efficacy of single intervention). (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3024725/; (Higgins and Green, 2008)).

3.2.2 The development of systematic review as a method

In 1753, the Scottish naval surgeon James Lind realised research synthesis was important to reduce bias in the interpretation of results (Volmink et al., 2004). Thorndike et al. (1916), used the average of the results of two studies to contrast the counting capabilities of children in outdoor and indoor environments. Additionally, research synthesis methods began to be used in physics and agriculture in 1932 (Chalmers et al., 2002). In 1972, the work 'Effectiveness and Efficiency: Random Reflections on Health Services' was published. The book proposed that a RCT was the best way to test health interventions (Cochrane, 2015). In 1979, Cochrane stated that all relevant RCTs should be collected for comprehensive analysis in the field of medicine and be constantly updated with the emergence of new clinical trials, in order to draw more reliable conclusions (Cochrane, 2000). In 1983, Furberg published the first systematic review of controlled trials in the field of health care: 'Effect of anti-arrhythmic drugs on mortality after myocardial infarction' (Furberg, 1983). In the 1980s, Archie Cochrane for the first time formally proposed the concept of systematic review in the literature related to pregnancy (Chaudhuri et al., 2005; Egger et al., 2008). In 1995, Lain Chalmers and Douglas G. Altman also defined the systematic review as a systematic evaluation approach to reducing bias and random errors in the data (Higgins and Green, 2008).

3.2.3 Conducting a systematic review

In this section, the general processes of systematic review as well as the principles involved will be discussed. Systematic review is the evaluation of each piece of literature included according to specific criteria. Subsequently all the data from the qualifying literature is combined to provide suggestions for the aetiology of a disease, besides the effects of therapy and drugs. This is an important method to reduce bias and promote evidence-based medi-

cine. If necessary, meta-analysis is performed. Meta-analysis can summarise all the data collected from different studies using statistical methods (Sackett et al., 1996; Bernardo et al., 2004; Gopalakrishnan and Ganeshkumar, 2013). A meta-analysis can provide an effect estimate of an intervention whether this is clinical, pharmacological, educational, etc.

A systematic review can collate, summarise and evaluate evidence on the aetiology and risk factors of disease, effectiveness of treatment, diagnostic methods, prognosis, cost-benefit analysis and more. The initial stage of the systematic review is to accurately describe the problem to be solved, including the types of people included in the study (the exact disease type, progression stages), the type of treatment or exposure factors, expected results, etc. This enables evaluation indicators to be properly selected (Ohlsson, 1996). What else needs to be defined in terms of population, interventions, comparators, outcomes and study designs (PICOS) (The Cochrane Collaboration, 2005).

The steps in a systematic review include defining an appropriate healthcare question, searching the literature, assessing the studies, combining the results and placing the findings in context (CRD, 2009). After a question has been proposed and criteria are defined, a comprehensive literature search can be developed and conducted. A comprehensive literature search is what differentiates a systematic review from the general literature review. When it comes to the literature search for the systematic review, there are some problems that require special attention. First, the retrieval should be timely, to avoid missing the latest literature. Second, all types of documents should be retrieved. Although RCTs are the most reliable source of evidence, other types of clinical trials should also be considered. Therefore, there is the need to develop a general search strategy for different types of research, one which pays the necessary attention to specificity, but also to sensitivity of the retrieve

(Haynes et al., 1994). When the research question is defined, inclusion and exclusion criteria should be formulated as well. Inclusion criteria are the standard that each study needs to meet so it can be included in this systematic review. Exclusion is usually a mirrored list of the inclusion criteria. When research meets the exclusion criteria, it should be excluded. Both inclusion and exclusion should be aligned with the aims of the systematic review.

After the literature search is completed, the next step is to collect the original literature. The collection is followed by literature screening. The reviewers must consider the quality of the studies obtained based on the PICO inclusion criteria (Cattran, 1999). The PICO framework includes the following variables: population of interest (P), intervention (I), comparative interventions (C) and the outcomes of interest (O) (The Cochrane Collaboration, 2005). While screening the literature, researchers should record all data collected for their study. Spread sheet software, such as Excel, and database system software such as FoxPro and Access, may be used for the data record (e.g. in the form of the tables). Tables should contain sampling methods, grouping measures, the number of samples in each group and research effects. Depending on the different purposes in research studies, measurements can include the rate difference, odds and the relative risk (including RR and OR) for example. Subsequently, data quality appraisal should be performed. 'Critical Appraisal Skills Programme' (CASP) is the most common tool to do this. The quality appraisal for the document retrieved should include two aspects: a) an appraisal of validity which includes internal validity and external validity (or generalisability) and b) conditions that the intervention is applied to. Conditions are closely related to the characteristics of the study objectives, methods and the selection criteria. For example, inconsistencies in doses drug trials, dosage form, route of administration and duration of treatment, can affect the interpretation of the results.

After quality appraisal, the results obtained from the included studies should be combined for analysis. In the process of the systematic review, the above quantitative statistical analysis of the epidemiological data is termed meta-analysis. Meta-analysis can achieve the following objectives: 1) improve statistical power; 2) consistent evaluation of results and resolution of conflicts between individual studies; 3) improve estimates of the role of effect. It should be noted that only when two series of data have high consistency can they be combined. This is determined by an assessment of heterogeneity. Heterogeneity in meta-analysis refers to the variation in study outcomes between studies. At present, the fixed effects and random effects models are common models used to combine the data. A forest plot is based on statistical indicators and statistical analysis methods. It is important to notice that in the Cartesian coordinate system, the vertical axis is indicating validity and the horizontal axis is the intervention's confidence intervals (CI). If the data is not suitable for meta-analysis, narrative synthesis may be the other way to combine it. Narrative synthesis is a flexible way to present the data. Authors simply need to describe the data effectively (Ryan, 2013).

When meta-analysis is finished, the next step is to discuss the analysis and draw a conclusion. In discussion, the research question(s) and research aims should be addressed based on the data analysis and explain how the findings could fit the knowledge. Authors should also make recommendations for policy makers and practice. The author should help readers correctly understand the relationship between articles providing evidence and clinical practice, and clearly point out the evidence to guide clinical practice. When evidence is insufficient to guide clinical practice, the authors should illustrate how to conduct in-depth clinical research trials, rather than use vague expressions such as 'needs further study' (Grebmeier et al., 2006).

3.2.4 Application of systematic review in healthcare

Systematic reviews could play a role in helping professionals to making decisions on how to improve medical care (Kaboli et al., 2006). Clinicians consult systematic reviews in order to address a variety of clinical problems around decision making, diagnosis, prevention and management.

An example of this is a study by Kaboli et al. (2006), which reviewed the literature published between the 1st of January 1985 and the 30th of April 2005 to evaluate the effectiveness of additional inpatient medical care by clinical pharmacists. In this case, 343 peer-reviewed articles were obtained. 60 articles met the inclusion criteria. It was found that the additional pharmacist services produced an improvement in the patients' health and caused no harm to them (Kaboli et al., 2006).

Flores and colleagues found another way to improve medical care when it comes to people with limited English proficiency. They searched 2,640 citations and established a research pool of 36 investigations (Flores, 2005). It was determined that interpreters play an important role in delivering medical care. Flores (2005), suggested that due to having only a basic understanding of medical terms, patients with low proficiency in English could have compromised their own treatment, leading to worse outcomes of medical care. However, the use of interpreters led to improved patient health outcomes (Flores, 2005).

Systematic reviews help to reduce healthcare services that are not needed. It was traditionally believed that cultural competence training was beneficial for medical skills and usually patients' adherence to therapies, which in turn was increased by cultural competence training and recognised as an indicator of medical care performance (Beach et al., 2005). Howev-

er, after a review of the literature from 1980 through to June 2003, it was established that there is no significant relationship between improvements in medical care and cultural competence training (Beach et al., 2005).

In another field of research, the use of artificial intelligence and computerised clinical decision support systems have changed what is possible in the provision of healthcare (Garg et al., 2005). Garg et al (2005), conducted a systematic review on the benefits of computerised clinical decision support systems related to the performance of health professionals and patient outcomes (Garg et al., 2005). After searching the literature from EMBASE, Inspec, MEDLINE, Cochrane Library and ISI databases, 64 articles found that the performance of the practitioner had improved but the medical care for patients remained the same (Garg et al., 2005).

A systematic review can sometimes provide unexpected results. Generally, physicians with more experience are expected to provide better health care for patients. Choudhry et al. (2005), conducted a systematic review of 62 studies that had been published evaluating the knowledge of physicians and the medical care they provided. The findings showed a negative relationship between experience and medical care performance. That is to say, lower-quality care is likely to be received from the most experienced doctors (Choudhry et al., 2005).

3.2.5 Summary

In summary, a systematic review is an effective evaluation tool in healthcare. It involves a comprehensive collection, evaluation and analysis of all relevant outcomes concerning a clinical or non-clinical problem. Quantitative synthesis is performed via a statistical analysis, if appropriate. When the data is not suitable for meta-analysis, narrative synthesis can be applied to combine the data. With ever-updated search engines, researchers can find literature

more specifically from a wide range of databases. The systematic review will be more realistic for decision making vis-à-vis medical care. Additionally, the systematic review is especially valuable when the potential advantages or disadvantages of a medical intervention are not confirmed, and variations exist in practice. If the quality of the systematic review is poor, it may lead to poor clinical decision making, consequently, poor policy-making.

3.3 Systematic review protocol as applied in the study

In the first phase of this study, a systematic review has been carried out on published literature with reference to RCTs on the effectiveness of exercise programmes on LPP among postnatal women. This review followed the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines (Moher et al., 2009). The review question was framed using the Population, Intervention, Comparator, Outcome and Study design (PICOS) framework (Schardt et al., 2007). This section will describe the systematic review method which included the review questions and identifying relevant work.

3.3.1 Background of this review

As discussed in the previous sections, LPP tends to be commonly reported among pregnant and postnatal women with varying prevalence rates. Women report LPP in pregnancy with prevalence rates ranging from 26.5% to 91% (Kumle et al., 2004; Mogren, 2005; Ayanniyi et al., 2006; Skaggs et al., 2007; Ansari et al., 2010; Chang et al., 2011; Al-Sayegh et al., 2012; Gjestland et al., 2012; Robinson et al., 2014). A substantial number of women continue to experience the pain in the postnatal period with varying intensity and duration (To and Wong, 2003; Thorell and Kristiansson, 2012). A higher range of variation is reported in LPP prevalence in the postnatal period compared to its prevalence in pregnancy due to differ-

ences in follow-up times, methods of measurement and definitions (Björklund et al., 2000; Líndal et al., 2000; Stapleton et al., 2002; Norén et al., 2002; Mogren, 2007; Olsson et al., 2012b; Thorell and Kristiansson, 2012; Robinson et al., 2014). For instance, using a self-rated VAS, Líndal et al. (2000), reported prevalence rates of 75% three days after delivery among women who had lower back pain in pregnancy and 54% at 90 days after delivery (Líndal et al., 2000). In a population based survey, Stapleton et al. (2002) found that 8% of women reported the onset of recurrent low back pain soon after pregnancy, whereas the figures rose to 13% one year after child birth (Stapleton et al., 2002). In another prospective cohort study of pregnant women, 28.9% of all pregnant women had some type of back pain during the index pregnancy and 5% had pain three years after birth (Norén et al., 2002).

The presence of LPP is often identified and confirmed by diagrammatic representations of self-reported pain location, alone or in combination with clinical tests (Nilsson-Wikmar et al., 2003; Nilsson-Wikmar et al., 2005; Gutke et al., 2010a; Robinson et al., 2010b; Gutke et al., 2011; Olsson et al., 2012a; Malmqvist et al., 2012; Robinson et al., 2014). Most LPP is reported in and around the lumbar area, which is responsible for supporting the majority of the upper body weight (Walker, 2012). Factors associated with LPP occurrence in pregnancy and in the postnatal period include maternal age, parity, high BMI, smoking, oral contraceptives, previous history of LPP, uncomfortable working conditions and lack of exercise (Björklund et al., 2000; Kumle et al., 2004; Wang et al., 2004; Mohseni-Bandpei et al., 2009; Bjelland et al., 2010; Al-Sayegh et al., 2012; Malmqvist et al., 2012).

Persistent LPP can negatively impact women's ability to perform daily activities and their quality of life. Among postnatal women, it has been shown that LPP leads to sleep problems, depression, fatigue, anxiety, and a general inability to do activities that involve carrying or

lifting (Cramp and Bray, 2010; Ko et al., 2008; Ko and Lee, 2014). For instance, Gutke et al. (2007), found that women suffering from LPP are three times more likely to experience symptoms of postnatal depression compared to those without (Gutke et al., 2007). In another study, 40% of women with postnatal LPP reported moderate to severe disability, with pain intensity being the major explanatory variable for disability level. The same study also found that the impact of having pelvic girdle pain, combined pain, or lumbar pain were equivalent in terms of disability, pain intensity, health-related quality of life, activity level and kinesiophobia (Gutke et al., 2011).

Different interventions have been used to reduce LPP in general, including exercise, acupuncture, drugs, therapies using heat/cold, traction, laser, ultrasound, shortwave diathermy, massage and corsets (Airaksinen et al., 2006; Perry, 2013). Clinical approaches for LPP management have specified the importance of the activation of muscles for motor control and stability of the lumbopelvic region (Richardson et al., 1999). Physical exercise has been indicated as a beneficial method to relieve LPP during pregnancy and after child birth (Garshasbi and Zadeh, 2005; Nilsson-Wikmar et al., 2005; Granath et al., 2006; Yan et al., 2014). Emerging studies on the effectiveness of exercise on LPP among postnatal women, however, appear to indicate mixed findings and do not provide sufficient evidence on their own to inform clinical practice in this area. A systematic synthesis of the existing evidence on the effectiveness of physical exercise on postnatal LPP is yet to be conducted.

3.3.2 Aim of this review

The aim of this systematic review was to synthesise findings from RCTs on the effectiveness of exercise on LPP among postnatal women to inform policy, practice and future research in the area.

3.3.3 Objective of this review

1) To assess the effectiveness of exercise interventions on back pain amongst post-partum women in comparison to no exercise.

3.3.4 PICOS model of this review question

The systematic review question was formulated in terms of PICOS. The requirements of inclusion in the initial stages of the search are to be as broad as possible to fulfil the aims of the study.

1) Population: postpartum women.

2) Intervention: exercise programmes /regimes.

3) Comparator: no exercise/other form of pain relief/exercise plus other form of pain relief.

4) Outcomes: Primary: back pain.

Secondary: physical endurance, changes in core muscles.

3.3.5 Inclusion criteria

For studies to be included in the review they must meet all the inclusion criteria. Inclusion criteria were: 1) study population is women who have back pain after the birth of a child 2) the clinical studies that take postpartum exercise as the main intervention, 3) have to have a RCT or control group and experimental group clinical research study, and 4) reported outcome measures include pain, physical endurance as well as changes in core muscles.

3.3.6 Exclusion criteria

Exclusion criteria were: 1) study reported other lower back pain interventions such as massage, hot compress, electrotherapy, medicine and surgery, 2) postpartum exercise impact: postpartum fatigue, postpartum depression and postpartum urinary incontinence, and 3) secondary research and not RCT design research.

3.3.7 Types of participants

Postpartum women with any type of back pain.

3.3.8 Types of studies

RCTs were eligible for inclusion if the reported intervention comprised of postnatal exercise for women who reported LPP onset during pregnancy or within 3 months after delivery.

3.3.9 Types of interventions

RCTs studying the above physical and rehabilitation interventions were included in this overview: exercise, exercise therapy, physical activity. The interventions comprised of physical therapy with a collection of exercise programmes specifically designed to strengthen deep local muscles and global muscles in the lumbopelvic region.

3.3.10 Types of outcome measures

The primary outcome measure was changes in LPP measured using a standardised measurement tool. The researcher used studies which included the following instruments: the VAS, McGill pain questionnaire, pain reduction scale, brief pain inventory and numeric rating scale. The secondary outcomes were physical endurance and changes in core muscles which will be measured by the DRI, Oswestry Lower Back Pain Disability Questionnaire (ODI), Que-

bec back pain disability questionnaire (QBPDS) and Roland Morris disability questionnaire (RMDQ) for physical endurance, and diastasis of the rectus abdominis muscle (DRAM) for the core muscles outcome measure.

3.3.11 Search strategy

The search strategy was designed to access both published and unpublished materials and comprised of three stages:

1) Limited search of CINAHL and Medline with the aim of recognising appropriate keywords found in the title, abstract and subject descriptors.

2) Recognised the words and synonyms employed by particular databases, subsequently used to perform a comprehensive search of the literature.

3) Reference lists and bibliographies of the articles collected from those identified in stage two above were searched.

3.3.12 Databases

Databases were searched from 1990 to 2014. Four search filters were combined to search each database: 1) interventions with postpartum women populations, 2) interventions focused on exercise or physical activity, 3) interventions focused on back pain, and 4) specify a randomised controlled trial design.

The databases searched included:

- CINAHL
- MEDLINE
- PUBMED

- PEDro
- SPORTDiscus
- Cochrane Central Register of Controlled trials
- Cochrane Pregnancy and Childbirth Groups Trials Register
- Centre for Reviews and Dissemination University of York

3.3.13 Search Terms for Electronic Databases

The key terms were used when devising search strategies for electronic databases. The exact search term and their results were recorded as the search strategy was refined. The key search terms used for searches across all databases are provided in Table 2. The retrieved articles were scanned for relevance based on the title, abstract and full text.

Table 2: Key search terms

1	Postpartum women OR "postnatal women" OR "after delivery" OR "postpartum period" OR "postpartum females" OR "birth" OR "after birth" OR "natal" OR "perinatal" OR "puerperium"	Population
2	Exercise OR "postpartum exercise" OR "postnatal exercise" OR "post-partum training" OR "postpartum practices" OR "abdominal training" OR "exercise prescription" OR " abdominal training " OR "female athlete" OR "physical activities" OR "physical fitness"	Interventions
4	Back pain OR "backache" OR " low back pain " OR " lower back pain " OR "upper back pain" OR "high back pain" OR "anterior pelvic pain" OR "posterior pelvic pain" OR "buttocks pain" OR "pelvic pain" OR "symphysis pain" OR "sacroiliac joint pain" OR "pelvic girdle pain" OR "lumbar pelvic pain" OR "lumbosacral pain" OR "lumbar pain" OR "postpartum-related LBP" OR "self-management of LBP" OR "vertebrogenic pain"	Outcome
5	Core muscles OR "trunk muscles" OR "core stabilisation" OR "transverses abdominis" OR "lumbar multifidus" OR "musculoskeletal" OR "musculoskeletal conditions" OR "musculoskeletal disorders"	
6	Physical endurance OR "endurance" OR "core muscle strength"	
7	1 AND 2 AND 3 AND 4 AND 5 AND 6	

3.3.14 Selection procedure

Full copies of articles identified by the search and considered to meet the inclusion criteria based on their title, abstract and subject descriptors, were obtained for data synthesis. Articles identified through reference list and bibliographic searches will also be considered for data collection based on their title. A PRISMA diagram was used to demonstrate the systematic search process (See Figure 4).

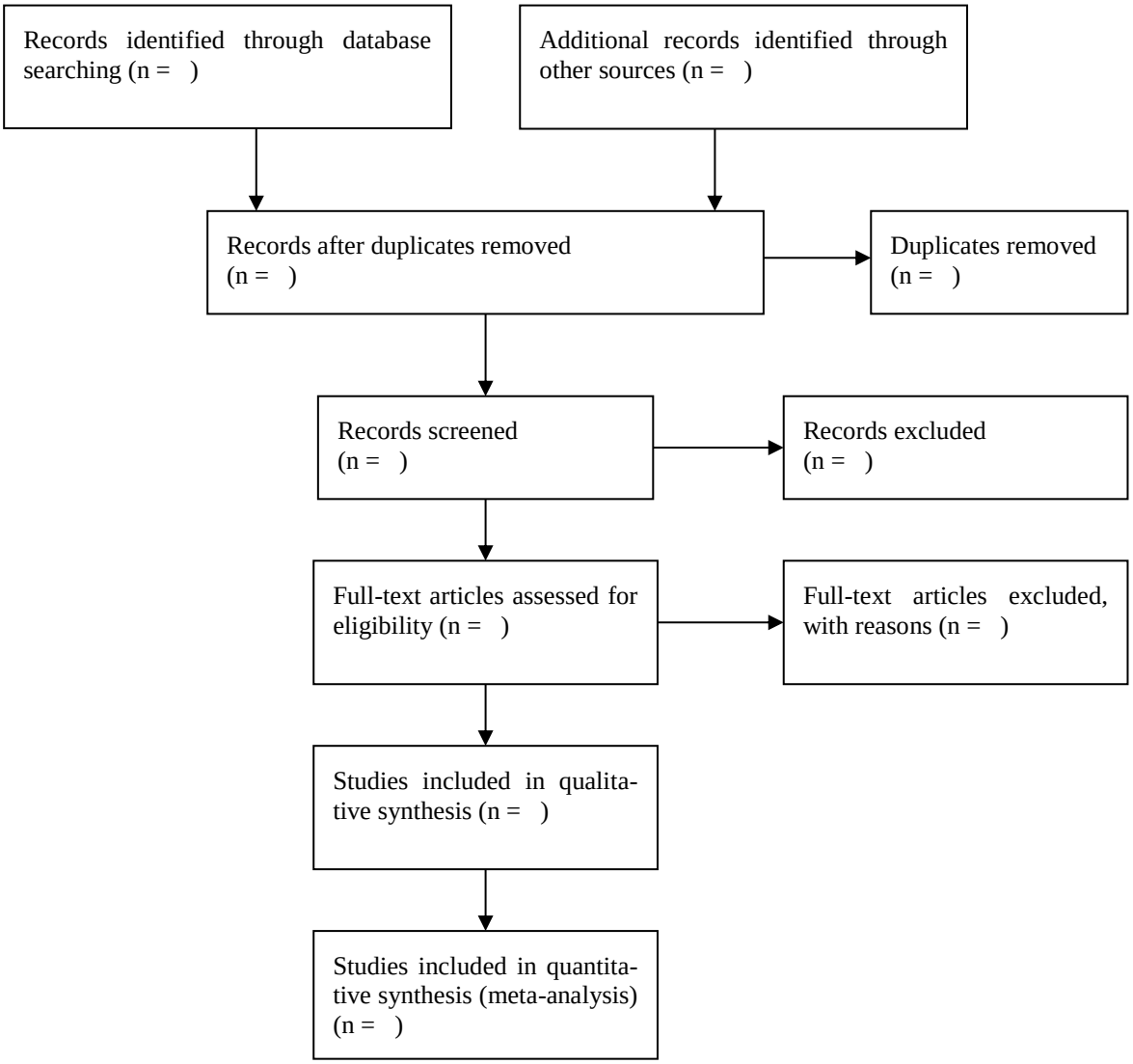


Figure 4: PRISMA 2009 Flow Diagram (Liberati et al., 2009)

3.3.15 Assessment of methodological quality

Studies meeting the inclusion criteria were assessed using the Physiotherapy Evidence Database (PEDro) for methodological quality of RCTs. PEDro is a web-based database of RCTs and systematic reviews in physiotherapy. It contains bibliographic details and abstracts of most English-language randomised trials and systematic reviews in physiotherapy, and moreover, provides an important information resource to support evidence-based clinical practice (Sherrington et al., 2000).

The PEDro scale was developed based on the Delphi list. The 11-item PEDro scale was designed for rating methodological quality of RCTs (PEDro scale link: http://www.pedro.org.au/english/downloads/pedro-scale/) Each satisfied item contributes one point toward the total PEDro score (range=0-10 points) apart from one item (item 1) that is not used to calculate the PEDro score due to external validity (Maher et al., 2003). The scores were added together, with higher scores representing better methodological quality. 9-10 were considered to be of "excellent" quality; "good" quality scores ranged from 6-8, and 4 or 5 were of "fair" quality (Foley et al., 2003).

3.3.16 Data extraction and synthesis

All included studies were exceptionally heterogeneous in nature; hence, narrative synthesis was used. Data extraction followed the Preferred Reporting Items for Systematic Reviews and the Meta Analyses (PRISMA) guidelines. The methodological quality assessment tool for selected articles were subsequently assessed using the PEDro Scale which consists of 11 items for rating the methodological quality of RCTs. The data from selected studies were extracted from tables comprising study characteristics along with quality assessment ratings

for each study. Heterogeneity in the present study was assessed using the fixed-effects model from pooled data.

Chapter 4

METHODOLOGY – PRAGMATIC TRIAL TO ASSESS THE EFFECTIVENESS AND ACCEPTABILITY OF AN EXERCISE PROGRAMME DELIVERED USING DVD, INTERNET OR LEAFLET (USUAL CARE), ON LPP AMONG POSTNATAL WOMEN

The second phase of the research involved a pragmatic trial, which aimed to assess the acceptability and effectiveness of DVD and Internet-based exercise interventions on postpartum LPP in Taiwanese women, compared to the usual intervention via leaflets. The chapter presents a discussion on RCTs and PRCTs and how they are being used in healthcare research and then move on to discuss how the PRCT was conducted in the current study including the ethical considerations of the study.

4.1 Aims and objectives

- The aim of the study was to assess the acceptability and effectiveness of DVD and internet-based exercise interventions on postpartum LPP in Taiwanese women, compared to usual instruction through leaflets.

Objectives

- To compare the effectiveness of three methods of instruction of exercise on postpartum LPP: DVD-based, Internet-based and leaflet based.
- To compare the acceptability (uptake, adherence and completion rate) of three modes of delivery: DVD-based, Internet-based and leaflet based.

4.2 Definition and development of RCTs

RCTs are a means of evaluating the effects of health services, drug therapy and different treatments. They are commonly used in medicine, biology and agronomy. The basic method of RCTs is that the participants are randomly assigned to different groups, where they are treated with different interventions to compare the differences in the effects of the intervention. Normally, a RCT involves experimental group(s) and a control group without any treatment. With a sufficient number of participants, this approach can ensure there are the same effects of the known and unknown confounding factors for each group.

In order to avoid artificial selection bias, participants are randomly assigned to study groups. Thus, the two or more groups involved in the trials are as similar as possible with respect to the baseline characteristics. That is to say, there are statistical comparisons amongst the groups. There are two main groups regarding the RCTs, i.e. the experiment group and the control group. The control group has two subdivisions; specifically, positive control and negative control. The positive group is receiving a treatment that has been identified as having known effects. This group can ensure the trials are not wasted if there are no significant treatment effects. The negative control group is not being treated or will be given a placebo. A placebo is to deceive the recipient so they would be emotionally stable even if they do not receive any treatment. If the patients are administered with a therapy, they should be in the experiment group. The control group does not usually receive any treatment or receive a placebo, which is the negative control. For example, a group in lung cancer research would like to identify if aspirin can reduce a cancer-related gene expression (assuming the gene is A). All the subjects might be divided into three groups. The first group is the control group, where no patient is administered with aspirin. The second group is the people who take 10mg of aspirin every day and the third group is patients taking 40mg of aspirin each day.

However, before they begin to take aspirin, the groups should be tested to make sure there is no significant difference in the expression of gene A amongst the three groups. This is the baseline test. This means that the reliability and validity of the results can be assured. Thus, the RCT method has been recognised worldwide as the 'gold standard' programme for the evaluation of the effects of interventions (Stolberg et al., 2004; Sullivan, 2011). Clinical prevention studies are also increasingly using this design.

It was in 1926 that RCTs were used in agricultural experiments for the first time by Ronald Aylmer Fisher. The RCTs were used in clinical studies evaluating the therapeutic efficacy of streptomycin for tuberculosis in 1946. After 1946, there were two RCTs published in 1948 and 1951 (Marshall et al., 1948). Nearly 60 years later, RCTs are widely used in clinical studies for the treatment of disease, prevention and rehabilitation.

Although RCTs are occasionally recognised as 'the best therapeutic study design', they do not solve all the research and clinical problems (Sullivan, 2011). In some cases, the use of RCTs is not feasible and not appropriate, such as diagnostic studies, aetiology and the prognosis of natural history.

RCTs are most commonly used in therapeutic or prophylactic studies, in order to investigate the exact effects of a particular intervention or preventive measure (medication, treatment options, screening methods, etc.). RCTs are able to provide a scientific basis for the correct medical decisions (Stolberg et al., 2004).

RCTs can also be applied to non-clinical trials such as education and agriculture. For example, to evaluate the teaching effects of an evidence-based medical education model and of the traditional medical education model, classes with similar conditions are randomly assigned

to specific groups. After the course has been completed, an assessment of teaching effects can be performed short or long-term (Stolberg et al., 2004).

4.2.1 Conducting RCTs

This section will discuss the processes involved in conducting an RCT as well as its methodological principles.

The whole procedure of RCTs can be summarised as sampling, sample qualification, group division and analysis as presented in the sections below. The procedure is also illustrated in the flow chart in Figure 5.

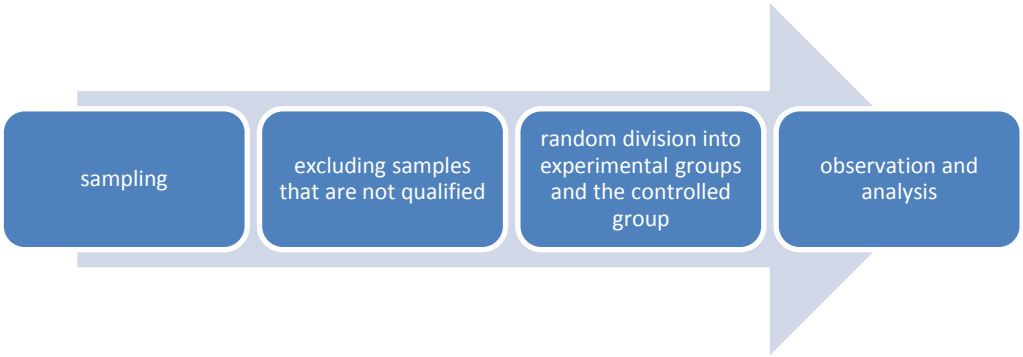


Figure 5: The flow chart for the RCTs.

4.2.1.1 Sampling and qualification

In RCTs, before sampling, the aim of the study should be defined as well as the qualification criteria for eligibility. According to the different aims of a study, participants can be volunteers, patients and a mixture of volunteers and patients. Based on the criteria, non-qualifying participants should be excluded. Reliability and baseline equality in RCTs increase with the use of greater samples. However, if the sample size is not large enough, the varia-

bles will not be distributed equally within each group, and the baseline will not be statistically comparable. The stratified random method could be applied to ensure comparability between the two groups (Stolberg et al., 2004).

4.2.1.2 Concealment

The aim in RCTs is to use a random, hidden allocation scheme, known as 'blind' allocation. The concealment has three levels: single blind, double blind and triple blind. This is put in place because researchers have sometimes expectations concerning the effectiveness of an intervention. If they recognise the group division method, they may focus on the effects of the new treatment. However, they may ignore the control group. This is the exaggeration of effects and it could be reduced by using double and triple blind concealment (Schulz et al., 1995). Single blind design means that the subject does not know the allocation. Double blind indicates that both the subject and investigators are not aware of the allocation. People who analyse the raw data, investigators and participants are not familiar with the allocation when triple blind trials are performed. Concealment allows eligible participants to have equal access to the experimental or the control group (Torgerson and Roberts, 1999).

4.2.1.3 Trial in progress

Following allocation, the trials can start formally. All the participants are tested with respect to the concealment. The principle of this is to run synchronised groups. This means that during the trials, two groups of (or sets of) participants in RCTs should be coordinated to receive the respective interventions whilst carrying out the research. Non-synchronisation will obviously affect the results of the study, which may lead to incorrect conclusions. Therefore, RCTs emphasise consistency and synchronisation of settings (Hollis and Campbell, 1999;

Kendall, 2003). In addition, the investigations should be performed at the same time and the setting should be the same as well.

4.2.1.4 Observation and analysis

It is important that the test and control groups of participants during the test should be consistent, which is another principle of RCTs (Sibbald and Roland, 1998). The allocation cannot be changed unless the situation changes. The observation duration of the test group cannot be longer than the control group, or vice versa, as an inconsistent duration during two observations can cause differences in the test results, leading to false conclusions. RCTs are prospective studies. A positive or negative result must be recorded after test participants have received corresponding research measures and experienced a period of effects. The principle of the analysis is that the quality and reliability of data obtained can be improved (Sibbald and Roland, 1998). The data can be analysed by different statistics software, such as SPSS, Mata lab and STAT.

In summary, RCTs are a means of evaluating the effects of health services, drug therapy and different treatments. RCTs utilise the double-blind and placebo-controlled methods. This is to ensure the homogeneity of the participants and comparability amongst groups. RCTs control the confounding factors that affect the trials results, and moreover, reduce selection bias and confounding bias as well. It is the strongest type of research to verify the 'causal link' between the intervention and treatment outcome and is considered the 'gold standard' for evaluation of the efficacy of interventions. However, in actual clinical environments, RCTs tend to idealise the conditions of design and the results have poor extrapolation.

4.3 Medical Definition and development of PRCTs

Whilst traditional RCTs assess the effect of interventions under ideal conditions, PRCTs are measurement trials for the effectiveness of an intervention under real life conditions (Patsopoulos, 2011). The trial design attempts to address the actual clinical setting and conditions. Increasingly more researchers are in favour of PRCTs (Hotopf, 2002), as they focus on the comparative efficacy of different interventions. Therefore, PRCTs can be classified as a comparative effectiveness research method. This section describes PRCTs from the perspective of design and application.

In 1967, Schwartz and Lellouch first proposed clinical trials having two different attitudes, i.e. pragmatic and explanatory attitudes of the difference, but this did not attract attention. In 1989, MacRae once again described the distinction between 'practical' and 'explanatory' research designs and distinguished between the terms efficacy and effectiveness (MacRae, 1989). By the late 1990s, PRCT was attracting more and more attention. From 1995 to 1999, Schwartz and Lellouch's article citation rate showed an increasing trend with an average of 24 times per year (McMahon, 2002). In recent years, most publishing editors have accepted the new design concept of PRCTs, and the understanding gap of the difference between explanatory experiments and the concept of 'pragmatic' is narrowing.

An example of PRCTs was applied in this area recently. Mutrie and colleagues employed PRCTs for the benefits of a supervised group exercise programme for women being treated for early stage breast cancer in 2007. In order to determine the effectiveness of 12 weeks of guided collective exercise as the treatment for early breast cancer patients, with follow-up of six months, a pragmatic prospective, randomised, open trial was designed**.** A total of 203 women took part in the study. 177 of them completed the follow-up of six months (Mutrie

et al., 2007). Patients were randomly grouped into two groups. Randomised stratification was based on treatment at the hospital and baseline treatment (chemotherapy, radiotherapy or combination therapy). This study was a prospective, randomised, open-label trial. Blind evaluation results were used. All subjects completed a functional assessment of cancer therapy questionnaire, Beck depression inventory, Body Mass Index measurements, positive and negative affect scale, seven day recall of physical activity, 12 minute walk test and assessment of shoulder mobility (Mutrie et al., 2007). Women in the intervention group were also instructed to participate in group exercise in addition to routine care in the health care group. The exercise programme lasted 12 weeks, encouraging patients to participate in two classes of exercise and an additional physical exercise at home each week. Exercise interventions were based on exercise guidelines for cancer patients. These women developed individualised exercise programmes with help from a professional before the end of the 12-week intervention. Women in the control group were given routine care from the health care group and completed the same overall assessment in the same time period.

After adjustment for stratification variables (study centre and baseline therapy), age and baseline values, a significant difference was observed between the intervention group and the control group at the end of the 12-week intervention and six months after the intervention (Mutrie et al., 2007). Compared with the control group, the intervention group showed body function and psychological benefits after 12 weeks of guided exercise. In addition to their recorded physical activity time, the other benefits from the intervention group were maintained from the end of the 12-week intervention to the six month follow-up. In addition to usual care, women with early breast cancer can benefit from collective guidance exercise in the course of treatment at the end of 12 weeks of exercise and six months follow-up in

terms of physical and psychological function (Mutrie et al., 2007). This article from the British Medical Journal confirms the validity of PRCTs in public health.

In addition, researchers are using a pragmatic RCT design to compare the effectiveness of different back pain treatments in medical practice. For example, a prospective single blind PRCT study by Cairns (2002), investigated the effectiveness of specific spinal stabilisation exercises within a physiotherapy treatment package for the management of recurrent low back pain patients, with follow up after discharge and at six and 12 months. The physiotherapy treatment package includes manual therapy, active exercises (McKenzie exercise-based and aerobic based exercises), lumbar traction, postural or ergonomic advice and electrotherapy. In Cairn's study, a two-armed PRCT design in clinical care, one arm received the physiotherapy treatment package and specific spinal stabilisation exercises. The specific spinal stabilisation exercises focused on increasing physical endurance on the deep abdominal and trunk muscles. The second arm received the physiotherapy treatment package only. There were a total of 97 patients in the study. 68 completed the follow-up of 12 months. Patients were randomly grouped into two groups and had 12 weeks of treatment. The outcome measures used the Roland Morris Disability Questionnaire and Oswestry Disability Index assessment of functional disability. The Short-Form 36 (SF-36) questionnaire was an assessment of quality of life outcome. Additionally, the Numerical Rating Scale and a short form of the McGill Pain Questionnaire were employed as measures of pain. After 12 months both groups were compared, the results indicate that the physiotherapy treatment package was effective in reducing functional disability and lower back pain. The spinal stabilisation exercises group did not provide any significantly different results in comparison with the physiotherapy treatment only group. The author reported that findings supported the physiotherapy treatment package contribution to clinical care and may challenge the benefits of

spinal stabilisation exercises for lower back pain in clinical care. However, this study validated a PRCT design in relation to the comparative effectiveness of different interventions in clinic practice regarding the recurrent LBP population (Cairns, 2002).

Lamb and colleagues used a PRCT design to compare the effectiveness of back skills training programmes on patients with lower back pain at 56 general practices in England. A total of 598 participants completed the Roland Morris Disability Questionnaire, modified Von Korff Scale, 12-Item Short Form Health Survey, Fear-Avoidance Beliefs Questionnaire and Pain Self-Efficacy Scale at three, six and 12 months. It should be mentioned that each of the participants received a 'back book' which is a novel patient educational booklet, developed to provide evidence-based information and advice consistent with current clinical guidelines, and a 15-minute advice session on active management prior to randomisation. The session included the benefits of an active back, symptom management and use of pain medication. Patients were randomly grouped into two groups. In the control group, participants did not receive any further intervention. Participants involved in the intervention group, attended a 10-hour back skills training programme, based on cognitive behavioural therapy. The results determined that participants in the back-skills training programme were more effective in managing lower back pain in primary care. Similarly, the intervention group experienced less pain intensity and back pain disability, and additionally, more improved physical health-related quality of life than the control group (Lamb et al., 2010).

Recently, protocols of two on-going PRCTs designed to investigate the effectiveness of treatments on patients with back pain in clinical care have been published (Sander et al., 2017; Shin et al., 2017). Sander and colleagues (2017), designed a multicentre PRCT at eight orthopaedic facilities in Germany. In the study, participant eligibility comprised patients aged

over 18, who were experiencing chronic back pain over six months and a depression assessment score by means of the Patient Health Questionnaire (PHQ-9) ≥ 5. If participants had a current depressive episode or depressive episodes within the last 6 months, or current dysthymia and a lifetime bipolar disorder, they were excluded from the study. After selection, participants were assigned to the intervention group and usual care group for six weeks. The intervention group was called eSano BackCare-DP, which undertook six weekly training sessions. Each session took 45-60 minutes and contents were provided by text, audio and video with information about depression and chronic back pain. Additionally, participants were encouraged by text message coaches and an eCoaches intervention platform to continue with the training for a 6-week training period. Participants in the usual care group were known as treatment-as-usual (TAU).

It should be mentioned that the participants who followed orthopaedic rehabilitation care received national treatment guidelines for lower back pain and depression, although the TAU group did not follow a standardised protocol and no minimum treatment was defined. All participants received assessments at pre-treatment and at 9 weeks, in addition to a 6 and 12-month follow-up complete with telephone interviews and questionnaires. This study was a psychological Internet and mobile-based intervention design to compare the effectiveness of eSano BackCare-DP and usual care for the prevention of chronic back pain in patients. The authors believe that this study will contribute to procedures related to chronic back pain and mental health treatment protocols and help to reduce the disease burden of depression for both affected people and society (Sander et al., 2017).

In another on-going PRCT in Korea, Shin et al. (2017), examined the comparative clinical effectiveness of Chuna Manual Therapy versus conventional usual care for chronic lower back

pain. The study comprised a three-arm randomised design, with participants randomly allocated to three groups; specifically, the Chuna group, usual care group and Chuna plus usual care group. Treatment time took six weeks. Chuna Manual Therapy is 10-18 hand skills therapy sessions administered via Chuna clinical specialists. It included spine flexion distraction (flexion, side bending, circumduction), side lying lumbar extension dysfunction correction technique, Iliopsoas fascial Chuna, Prone iliac anterior/posterior rotation dysfunction correction technique, etc. Moreover, the conventional usual care group received orally administered medicine, physical therapy and back pain care education. In this case, the combined group received Manual Therapy Chuna and conventional usual care, and the study intervention period took six weeks. For outcome measurements, the NRS will be used to measure lower back pain intensity over the past week. Functional status will use the Oswestry Disability Index (ODI) questionnaire, while the EuroQol-5 dimensions (EQ-5D) health survey assessed individuals for health-related quality of life. The authors claim that the reason for this study was to investigate the clinical effectiveness of Chuna (a Korean spinal manual therapy) or usual care in real-world clinical practice and the contribution of rigorous clinical studies on Chuna in Korea (Shin et al., 2017).

As discussed in the previous sections, PRCTs have been applied to compare different treatments and the efficacy of a therapy and have helped clinicians to understand which treatment can be implemented and improve the treatment of disease in medical practice.

4.3.1 Process involved in conducting PRCTs

As mentioned in the previous sections, PRCTs aim to explore the effects of interventions in the actual clinical environment, rather than under ideal conditions. Moreover, the conditions of PRCTs are more leniently controlled. The participants are randomly assigned to treatment,

although the remaining conditions should simulate real clinical situations as much as possible, emphasising the external validity of the conclusions (Patsopoulos, 2011). On the basis of randomness, comparability and representative principles, the selection of the participants in a PRCT should be close to the actual situation where the study is clinical, so its inclusion and exclusion criteria will be relatively wide (Schwartz and Lellouch, 1967; Roland and Torgerson, 1998; Tunis et al., 2003; Meissner et al., 2013). After sampling, some participants should be excluded based on the criteria. The PRCTs reflect the heterogeneity of the population in the clinical practice as much as possible, hence, there are fewer exclusion criteria. Participants who are included are frequently real people, such as patients with poor compliance, patients with complications or participants using other drugs. The criteria can be formulated based on broad diagnostic groups rather than a particular clinical group. The definition of the study objectives can be an expressed with its wide range of applications, rather than a unified standard diagnostic classification.

With respect to participant allocation, PRCTs have a more flexible randomised allocation. Based on a real research situation, participants can be allocated according to persons', groups', experts' or even patients' wishes. PRCTs require blind trials, but, depending on clinical practice, the double blind between physicians and patients is actually difficult. PRCTs emphasise the blind amongst investigators, data collectors and data analysers. PRCTs are generally a comparison, and contrast the efficacy of two types of interventions, not simply selecting a placebo as the control group (Schwartz and Lellouch, 1967; Roland and Torgerson, 1998; Tunis et al., 2003; Meissner et al., 2013). Possible control measures include a blank control, basic treatment, standard treatment, or other intervention controls, where the application of the 'blank' follows ethics. For those patients who must receive treatment, both the blank and the placebo is not applicable.

Finally, the observation and analysis should be comprehensive. PRCTs focus on complex interventions, meaning that PRCTs 'package' all the effects of the interventions. The evaluation is the total effect of complex interventions. It allows the clinician or patient to select preferable treatment and to change treatment. The same treatment is not necessarily available to every patient. PRCTs should assess the entire process the patients benefit from. It emphasises the clinical endpoint outcomes, such as the incidence of stroke and improvement in the quality of life. It is also noticeable that the follow-up is longer (Roland and Torgerson, 1998). Moreover, for the analysis methods, PRCTs can refer to RCT statistical analysis methods. However, if the primary outcome measure was a patient-reported subjective outcome or even a qualitative description, it will describe and analyse the data according to methods of qualitative research (Roland and Torgerson, 1998).

In summary, the characteristics of PRCT methodology make it more suitable for the evaluation of complex interventions. Because of its focus on the effectiveness of comparison, design ideas fit the realities of clinical practice. Therefore, in contrast to the classical randomised double-blind placebo-controlled trials, patient compliance is higher, and the findings have better external validity (Meissner et al., 2013).

4.3.2 Rationale and justification for the PRCT in phase 2 of the current study

As mentioned before, it is well known that interpretive RCTs employ a double-blind, placebo-controlled approach that maximises the homogeneity of the subject and the comparability of the groups, in addition to controlling the confounding factors that influence the outcome of the trial, thus reducing selectivity bias and confounding bias. RCTs are the strongest type of evidence that validates the causal link between intervention and treatment out-

comes, and are therefore known as the 'gold standard' for evaluating the efficacy of interventions (Verhoef et al., 2002).

However, considering the actual clinical setting, the conditional design of interpretive RCT tends to be idealised, seeing as the RCT focuses one treatment on the condition that variables, in relation to the patients, are as least as possible (Hay et al., 2003). In reality, patients usually receive more than one treatment and their eating habits and lifestyle also affect the results of the treatment they receive. Pragmatic randomised controlled trials (PRCTs), on the one hand, meet the basic elements of RCT design. For example, treatments are assigned for different groups randomly. Conversely, the methodology is close to the actual clinical environment and conditions, which is more and more favoured by researchers. For instance, patients can receive treatment in either hospital or home, while all patients do not have this freedom in RCTs. For the reason that PRCTs focus on comparing the effectiveness of different interventions, they can be classified in the comparative effects of the study.

Why was PRCT chosen for Phase 2 of the quantitative study? Phase 2 of the quantitative study focuses on comparing the effectiveness of three methods of instruction of exercise on postpartum LPP and comparing the uptake, adherence and completion rate of three modes of delivery. The study trial design attempts to address the actual clinical environment and conditions. In Taiwan, a new mother will be given instructions by hospitals on postpartum exercise, as part of her routine care. This specific set of postpartum exercise instructions has been provided to new mothers since 1971. The exercise programme comprises strengthening core abdominal and global muscles through abdominal muscle exercises, breathing exercises, head and neck exercises and leg exercises. It is recommended women should exercise twice a day for 30 minutes. As it is part of routine care in a real clinical environment and

conditions, women receive the postpartum exercise leaflet and subsequently go home. The hospitals do not follow-up and show women how to implement the exercise. However, the Phase 2 quantitative study design includes a PRCT, and is a comparative efficacy of different interventions (DVD-based, Internet-based, and leaflet based of three methods of exercise instruction) under real life conditions (Taiwanese women postpartum period with exercise).

4.4 PRCT Design in the current study

4.4.1 Design

The phase two of the current study used a prospective, single blind, PRCT to compare two intervention groups with a control group. This type of study design is useful for answering questions when compared to standard or accepted treatment, and beneficial to determining the effectiveness of the intervention in routine clinical practice (MacPherson, 2004). The pragmatic trial features were used to ascertain the effectiveness of the postpartum exercise intervention in a routine care setting, where the outcomes were measured at six weeks and four months follow-up. In addition, this trial is not placebo controlled. In this study, the two intervention groups consist of participants instructed via either DVD or via an online video (DVD and Internet-based), whereas the control group participants follow the usual instructions provided via the leaflet. The study protocol was registered with the International Standard Randomised Controlled Trials Number (ISRCTN) (ISRCTN registry Trial ID ISRCTN51146251; http://www.isrctn.com/ISRCTN51146251).

4.4.2 Study Setting

The study was conducted in the Shin Kong Medical Centre Hospital in the north of Taiwan. The island of Taiwan lies some 180 kilometres (110 miles) off the south eastern coast of

mainland China across the Taiwan Strait and covers an area of 35,883 km2 (13,855 sq mi). Taiwan's population was estimated to be 23,532,065 in November 2016, with the number of births at 188,551 (Ministry of the Interior, 2017). The Shin Kong Medical Centre Hospital is located in the north of Taiwan and had 2,150 births in 2015, of which 1,312 were 'primipara' (via normal delivery).

4.4.3 Participant eligibility

All adult (aged 18 or older) mothers who delivered their babies in Shin Kong Medical Centre Hospital and have attended their prenatal care between 34 and 41 weeks were invited to participate in the study. Study inclusion criteria were as follows: 1) primipara and single-foetal pregnancy, 2) without LPP before pregnancy, 3) pregnant women who had LPP in the region of the lower back and/or anterior and/or posterior region of the pelvis (Olsson et al., 2012a) and pain intensity on VAS via self-report point on or over 30 mm in the past week. 4) no puerperal complications or complications with the baby, 5) normal spontaneous delivery, 6) willing to provide informed consent for participation, and 7) able to complete written forms in mandarin. The study excluded mothers who had clinician-reported contraindications for exercise and any diagnosis of spinal problems before pregnancy.

4.4.4 Recruitment

Pregnant women were recruited during their 34 to 41 gestation week's prenatal visit by a research midwife at a prenatal care registration room in the Obstetrics and Gynaecology outpatient department of the Shin Kong Medical Centre Hospital. The research midwife, who has over ten years of experience of working in the Obstetrics department, received training on research protocols prior to data collection prior to the recruitment of the participants. The training covered elements such as the study process; selection participants based on the

inclusion and exclusion criteria; how to conduct the randomisation; how to explain the study information sheet and consent form; as well as how to use the questionnaires and a physical examination.

To avoid errors regarding the inter-rater reliability and intra-rater reliability of measurement data, the researcher herself and the research midwife conducted separate measurements on ten postpartum women (volunteers from postpartum wards) and compared the data consistency. The research midwife conducted the measurements twice on each woman. The Inter-rater reliability had a 90% agreement between the researcher and the research midwife. Second, the intra-rater reliability was 90% consistent. During the initial recruitment, the research midwife followed the participant eligibility protocol. When women matched the participant eligibility, the research midwife used the information sheet to explain the purpose of the study. Once participants understood and agreed to enrol in the study, they were asked to sign an informed consent form and complete baseline questionnaires (Demographic questionnaire, VAS and DRI). Participants eligible for inclusion and who had signed the consent form, were randomly allocated to one of three groups (intervention: DVD-based and Internet-based or control: Usual Care group).

During the intervention period, the research midwife visited the delivery ward to check the birth list and if prospective participants initially recruited had a normal delivery. A Research Passport was obtained by the researcher and ethics approval was sought from the hospital's nursing department.

4.4.5 Randomisation

Participants eligible for inclusion were randomly allocated to one of three groups (DVD-based, Internet-based, usual care). Randomisation was managed by investigators using a list that was created by a random allocation software package using a random sample list (Saghaei, 2004). The process involved preparing a random allocation list according to a 1: 1: 1 randomisation sequence from a computer-generated random-number table (See Appendix 1). The random allocation software design avoided any potential allocation bias with all the participants getting an equal chance to be allocated into any one of the groups. Participants were blinded at recruitment regarding their allocation to the intervention or control groups.

4.4.6 The intervention

In the PRCT study, the researcher used the general postpartum exercise programme recommended by hospitals for postnatal women in Taiwan. The intervention comprises an exercise programme (See Appendix 2 for an English translation of the components) recommended by hospitals for postnatal women in Taiwan delivered through digital media (DVD and the Internet). The exercise programme is designed to strengthen core abdominal and global muscles through abdominal muscle exercises, breathing exercises, head and neck exercises and leg exercises. The programme consisted of eight components to be performed at several time points after giving birth. Women were asked to undertake the exercises two times each day for a period of 30 minutes. The outcomes were measured at baseline, six weeks and four months follow-up. The leaflet contained information on the purpose of the exercise, the detailed components, the required duration and frequency. The leaflet only provided information on the exercises via words and pictures.

4.4.6.1 Development of exercise video

The researcher used the components of the postpartum exercise programme in the leaflet to develop the intervention video that was administered to participants in the DVD-based group and Internet-based group. The video production was informed by the multimedia learning theoretical model. This section describes the process of the development of the exercise video. Although the exercise video, was made up of the same exercise programme as in the leaflet, the video included images, sounds, words, animations and demonstrations of the exercises based on the multimedia learning theory (Hung et al., 2011). This will improve the participants' working memory, which will subsequently be transformed to long-term memory. Finally, the long-term memory will become exercise knowledge in the participant's memory.

The information contained in the different sections of the leaflet was transformed in to the video as described below:

a) Part 1: Purpose of the exercise

Concurrent to the exercise programme in the leaflet, the purpose was illustrated in three items. This included 1) promoting the recovery of maternal physical function, 2) to help maternal pelvic ligament arrangement recovery, abdominal and pelvic muscle function recovery, and 3) to improve the buttocks, abdomen and compaction of the chest muscles.(See Figure 6).

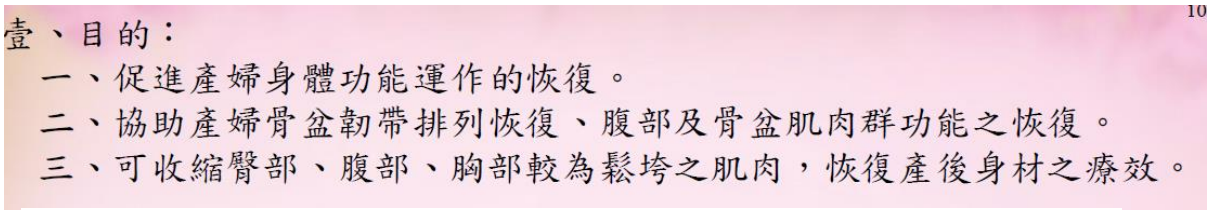


Figure 6: Purpose of the exercise (leaflet)

The video detailed the purpose and benefits of the exercises via colourful animations, illustration sounds and soft music in the background. The video employed animation to explain the reasons for LPP, which included 1) hormonal changes which cause global relaxation to the ligaments and muscles, 2) several anatomical changes created by global laxity in the muscles and ligaments which can compromise the stability of the spine, 3) spinal stabilisers, for instance the abdominal muscles, lose their tone, as do the muscles and ligaments surrounding the spinal column. As a result, the body's ability to stabilise the spine is diminished, 4) throughout pregnancy instability of the spine gradually increases. Moreover, changes in posture caused by pregnancy and the spine's increased instability can cause back pain in some women when they are pregnant and after giving birth (See Figures 7).

Figure 7: Some of the contents of the video (purpose of exercise)

Several of the benefits of postpartum exercise were presented via illustrations. The presented benefits included: 1) lifelong benefits of exercise, 2) muscle strength and toning, 3) improved physical and mental wellbeing, 4) weight loss, improved cardiovascular fitness and muscle strength, conditioning of abdominal muscles, improved mood, less stress and prevention of postpartum depression (See Figure 8). Part 1 of the video takes two minutes and 40 seconds.

Figure 8 : Some of the contents of the video (Benefits of exercise)

b) Part 2: Things to remember regarding postpartum exercises:

In the leaflets, the section 'things to remember' was presented in the last part of the exercise instruction (part 3). In the video (DVD and Internet), the section 'things to remember regarding postpartum exercises' was moved to Part 2, because the participants should notice it before they perform the exercises.

The contents of Part 2 include: 1) Empty your bladder before exercising, 2) Avoid exercising one hour before and after a meal, 3) Invest in a good support bra, 4) You should do your exercises on a hard surface, such as a firm bed, tatami cushion or on the floor, 5) You should breathe deeply and keep your motions unhurried while exercising, 6) Make sure you drink

lots of water to replenish yourself, especially when breast-feeding, 7) Listen to your body. If you're feeling tired, go easy on yourself. Try not to push yourself until you feel ready, 8) If you start to feel light headed and nauseous, or notice a change in the colour of your vaginal discharge, consult your doctor (See Figure 9). Part 2 of the video takes 15 seconds.

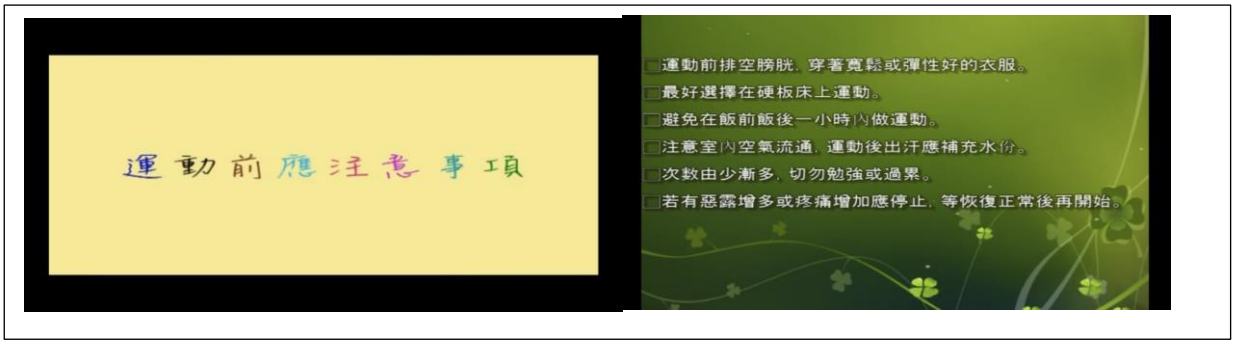


Figure 9: Some of the contents of the video (Things to remember regarding postpartum exercises)

c) Part 3: Components of the exercise programme

The exercise programme consisted of eight components using pictures and text as instruction techniques. This included the purpose and timing of each exercise (see Figure 10).

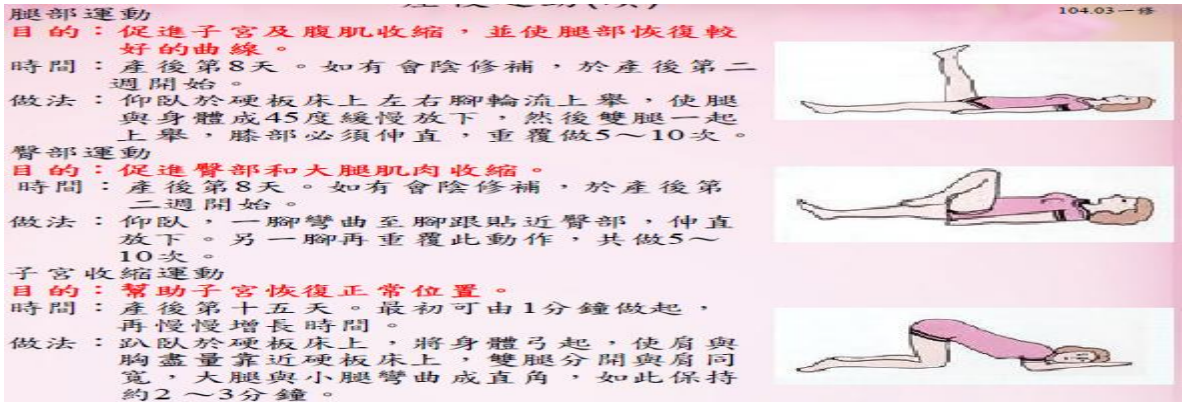


Figure 10 : Exercise programme (leaflets)

The video was developed to demonstrate eight exercises. The eight exercises include: 1) abdominal breathing exercises, 2) head and neck exercises, 3) breast exercises, 4) leg exercises, 5) gluteus exercises, 6) vaginal contraction exercise, 7) knee-to-chest exercises, and 8) abdominal muscle exercises. Before each exercise started, the video provided instructions explaining the exercise movements, and the purpose and timing of the exercise (See Figures 11). The video used sounds (voiceover) and words (See Figures 12). Part 3 of the video takes six minutes and 44 seconds.

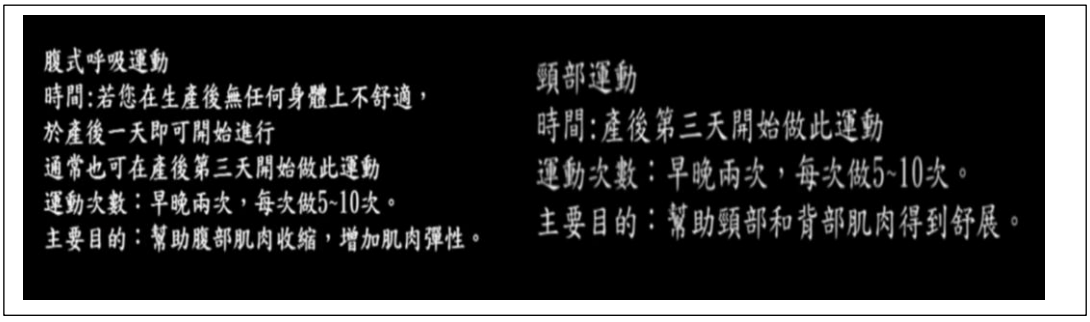


Figure 11: Some of the contents of the video (exercise instructions)

Figure 12: Some of the contents of the video (model demonstrating the exercises)

4.4.6.2 The exercise video with multimedia learning theory framework

The exercise video was developed by using the instructions from the postpartum exercise programme used in the leaflet and according to the five steps of the multimedia learning theory (See Section 2.5.1). According to the knowledge representation of physical representation methods, the video instruction built on its capacity to use visual as well as auditory stimuli.

Following the foundations of the sensory representations in the Multimedia Learning Theory, participants in the video-based groups received a comprehensive stimulation of senses via music and voiceover in addition to the visual stimuli. The participants who experienced the exercise programme only via written text and images, in the Usual Care group, had the instruction information be assimilated into 'shallow working memory' representations (Baddeley and Hitch, 1974). The instruction information for the participants in the video-based groups is expected to be stored as 'deep working memory representations', according to Multimedia Learning Theory. Multimedia Learning Theory demonstrates how more comprehensive stimulation of the senses via auditory as well as visual instruction may have an impact on the motivation of the participants to uptake and adhere to the instruction.

The video was developed by nurses in Taiwan and initially used in the pilot study. The pilot study was implemented from 01.03.2015 - 23.03.2015 at Shin Kong Medical Centre Hospital in Taiwan, Taipei. Of the 15 people who responded to the recruitment strategies, nine participants met all of the inclusion criteria and indicated that they were available during the testing period. To test the feasibility of the exercise video, six participants (DVD-based group (3) and Internet-based group (3)) used the video to undertake the exercises. In the pilot follow up (two weeks), the research midwife held face-to-face interviews with the participants,

asked about the practicability of the video, and moreover, discussed the advantages and disadvantages of video and participant's views on each part.

In Part 1 of the video-based instruction, which details the purpose of the exercise and benefits of postpartum exercise, six participants indicated that the brief that related to the animation can help to have a greater understanding of why they have LLP and how important it is to do the exercises. The participants reported that Part 2 which presents 'things to remember regarding postpartum exercises' were thoroughly understood. Concerning Part 3, the actual exercise instruction, the participants indicated that they were able to follow the exercises, the exercise examples and the exercises speed were suitable, and the commentary was relevant to the visual element of the video. Moreover, the participants pointed out that they could select from the menu which part of the video they wished to watch and use.

4.4.7 DVD-based group

Women in the DVD-based group received the exercise video from the research midwife. When the women had a normal delivery, the research midwife visited them on the postpartum ward, using a DVD player to demonstrate the postpartum exercise. Following the brief demonstration, the research midwife offered to answer any questions the women might have had relating to the exercises.

After watching the video, participants completed the questionnaires (VAS, DRI) and physical examinations (body weight, waist circumference and diastasis recti). The research midwife gave the participants the self-recording sheet and explained how to use it. The research midwife and the participants had to make appointments for six weeks and four months follow ups. At the follow-up time, the questionnaires (VAS, DRI) and physical examinations (body weight, waist circumference and diastasis recti) were completed.

4.4.8 Internet-based group

The exercise video was posted on YouTube (http://youtu.be/ho0ECXsM-04) and women allocated in the Internet-based group were provided with instructions on locating the video link on YouTube. The midwife used participants' phones or laptops to obtain the internet link on YouTube to instruct the postpartum exercise and answer any questions. The research midwife gave out the questionnaires, exercise self-recording sheet, conducted the physical examinations and arranged follow-up appointments. Each of the participants in both groups (DVD and Internet-based) received the same verbal instructions from the research midwife.

4.4.9 Usual care group

Women in the control group received standard postnatal care which includes the customary information given by their nurses along with the leaflet (See Appendix 3). The nurse only uses the postpartum exercise leaflet to instruct the participants how to perform the exercise. The leaflet contains the purpose of the exercise, benefits, details of the exercise components and the required duration and frequency. The research midwife did not answer any questions relating to the exercises for the control group. If the participants had any questions concerning the exercises, they were referred to the nurses. The research midwife gave out the questionnaires, exercise self-recording sheet, undertook the physical examinations and arranged follow-up appointments.

4.4.10 Outcomes Measures

The primary outcome measure was reported LPP, measured by the VAS tool. The secondary outcome measures were physical endurance and changes in core muscles. The physical endurance score is the DRI; changes in core muscles were measured by physical testing and

diastasis recti. Acceptability of exercise was measured by using a self-record sheet. The following measures were completed at baseline (first available chance postpartum), 3 days, 6 weeks and 4 months postpartum. The VAS, DRI and self-recording sheet were used for self-assessment by the participants. Physical examinations, including measurement of waist circumference, body weight and diastasis recti, were measured by a researcher midwife.

4.4.11 Measurement tools

4.4.11.1 VAS

Changes in LPP intensity among postnatal women were measured based on the VAS assessment, which is a uni-dimensional measure of pain intensity (McCormack et al., 1988). The VAS is a continuous scale comprised of a horizontal (HVAS) or vertical (VVAS) line, usually 10 centimetres (100 mm) in length (Jensen et al., 1986). The scale is most commonly anchored by 'no pain' (score of 0) and 'pain as bad as it could be' or 'worst imaginable pain' (score of 100 [100-mm scale]) (Huskisson, 1974; Myles et al., 1999; Johnson, 2006; Hawker et al., 2011). The VAS is a self-reporting tool and respondents were asked to report 'current' pain intensity or pain intensity 'in the last 24 hours' by placing a perpendicular line to the VAS line at the point that represents their pain intensity. The pain score is determined by measuring the distance (mm) on the 10-cm line between the 'no pain' anchor and the patient's mark, providing a range of scores from 0–100 (Burckhardt and Jones, 2003; Kane et al., 2005; Hawker et al., 2011) (See Appendix 4).

4.4.11.2 DRI

Physical endurance was measured using the DRI (Salén et al., 1994). The DRI has been tested on patients undergoing rehabilitation for neck, shoulder and low-back pain, and it has

demonstrated enhanced reliability and validity for assessing disability (Salén et al., 1994). It has also been used for women with back pain postpartum in previous studies (Nilsson-Wikmar et al., 2003, 2005). The DRI consists of a 12-item questionnaire that evaluates physical functions including the following activities: 'dressing; outdoor walks; climbing stairs; sitting for a longer time; standing bent over a sink; carrying a bag; making a bed; running; light work; heavy work; lifting heavy objects; participating in exercise/sports' (Longo et al., 2010, p.126). The 12 items are divided into three categories: basic daily life activities (questions 1–4); physical activities (questions 5-8); and work-related/vigorous activities (questions 9–12). Each item is scored with a 100 mm VAS. Respondents are asked to mark a point on the line representing their ability to perform the daily activities included in the list of questions by placing a perpendicular line to the VAS line at the point that represents their difficulty in carrying out these activities. The score is determined by measuring the distance (mm) on the 10-cm line between 'without difficulty' (0 points) and 'not at all' (100 points). The mean of these measurements for all the items on the questionnaire was calculated with the final DRI score expressed as a percentage (Salén et al., 1994; Longo et al., 2010) (See Appendix 4).

4.4.11.3 Physical examination

Changes in core muscles were measured via a series of physical examinations, including measurements of waist circumference, body weight and diastasis recti, performed by a trained research midwife. The measurement tools were an electronic body weightometer (estimate to the first decimal place) for body weight and a stretch-resistant tape (includes millimetre) for waist circumference. The research midwife conducted each physical examination twice, at every appointment, to ensure the examination results were consistent.

a) Body weight was measured with the participant wearing light clothes and with their shoes off. Participants were instructed to void the bladder before weight was measured.

b) Waist circumference was measured following the standardised procedure (See Figure 13) according to the World Health Organisation waist circumference and waist-hip ratio protocols (WHO, 2011). The research midwife followed the waist circumference measurement standards. These included: 1) use of the same stretch-resistant tape to measure. 2) have the correct posture during the measurement, 'the subject stands with arms at their sides, feet positioned close together and weight evenly distributed across the feet'. 3) 'the waist circumference should be measured at the end of a normal expiration, when the lungs are at their functional residual capacity'. 4) 'the subject to relax and take a few deep, natural breaths before the actual measurement is made, to minimise the inward pull of the abdominal contents during the waist measurement', 5) 'the measurement be made at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest' (WHO, 2011).

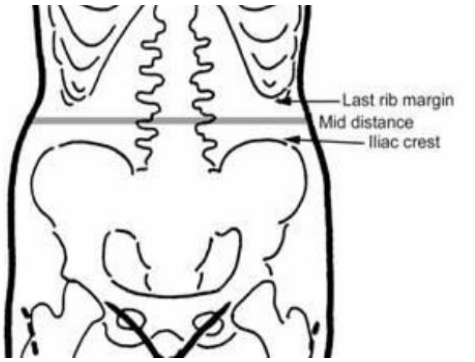
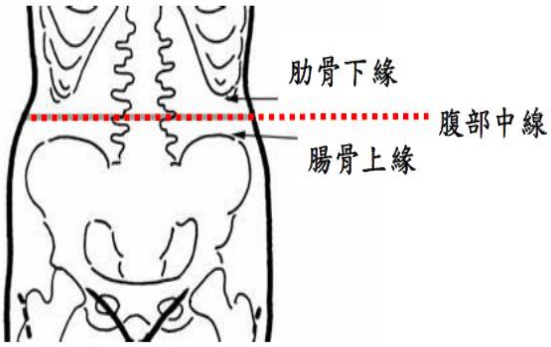
Waist circumference standards	測量腰圍標準
1) Each time use some stretch-resistant tape to measure.	1）每次使用相同的皮尺進行測量。
2) Make correct participants posture during the measurement, 'the subject stands with arms at the sides, feet positioned close together, and weight evenly distributed across the feet'.	2）在測量過程中確保參與者的姿勢正確，個案站立時雙臂交叉，雙 腳併攏，雙腳均勻分佈站立。
3) 'The waist circumference should be measured at the end of a normal expiration, when the lungs are at their functional residual capacity'.	3）測量時機為個案在正常呼氣末期，當肺處於其功能殘氣容量時，此 時為測量並記錄腰圍最好的時間點。
4) 'The subject to relax and take a few deep, natural breaths before the actual measurement is made, to minimize the inward pull of the abdominal contents during the waist measurement'	4）在進行實際測量之前，讓受試者放鬆並進行幾次深呼吸，以盡量減 少在腰圍測量過程中腹部內容物的向內拉動。
5) 'The measurement be made at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest', the tape should be positioned horizontally, parallel to the floor.	5）測量點:在最後一根可觸及肋骨下緣與髂嵴頂部之間的近似中點進行測量 ， 皮尺應水平放置，平行於地面。
	
(WHO, 2011)	(世界衛生組織，2011）

Figure 13: Waist circumference measure standardised procedure.

c) The Diastasis Recti test was performed by the research midwife guiding palpation of the abdominal wall using the standardised process (Boissonnault and Blaschak, 1988). In a lying

position, the participant was asked to lift her head and shoulders off the table with arms extended, reaching toward the knees until the spine of the scapula left the table as palpated by the examiner's hand. When the participant was in this position, the examiner measured diastasis recti abdominis by placing her fingers horizontally across the linea alba, determining how many fingers fit into the space between the borders of the two rectus abdominis muscles. Measurements were taken 4.5cm above, 4.5cm below, and at the umbilicus. Furthermore, the research midwife used stretch-resistant tape and a pen to make three lines (4.5cm above, 4.5cm below and at the umbilicus) on participants' abdomens (See Figure 14). The measurement result was classified and considered normal if it consisted of any separation above, below, or at the umbilicus of two finger widths or less, whereas greater than two finger widths constituted a diastasis recti abdominis (Boissonnault and Blaschak, 1988)(See Appendix 5).

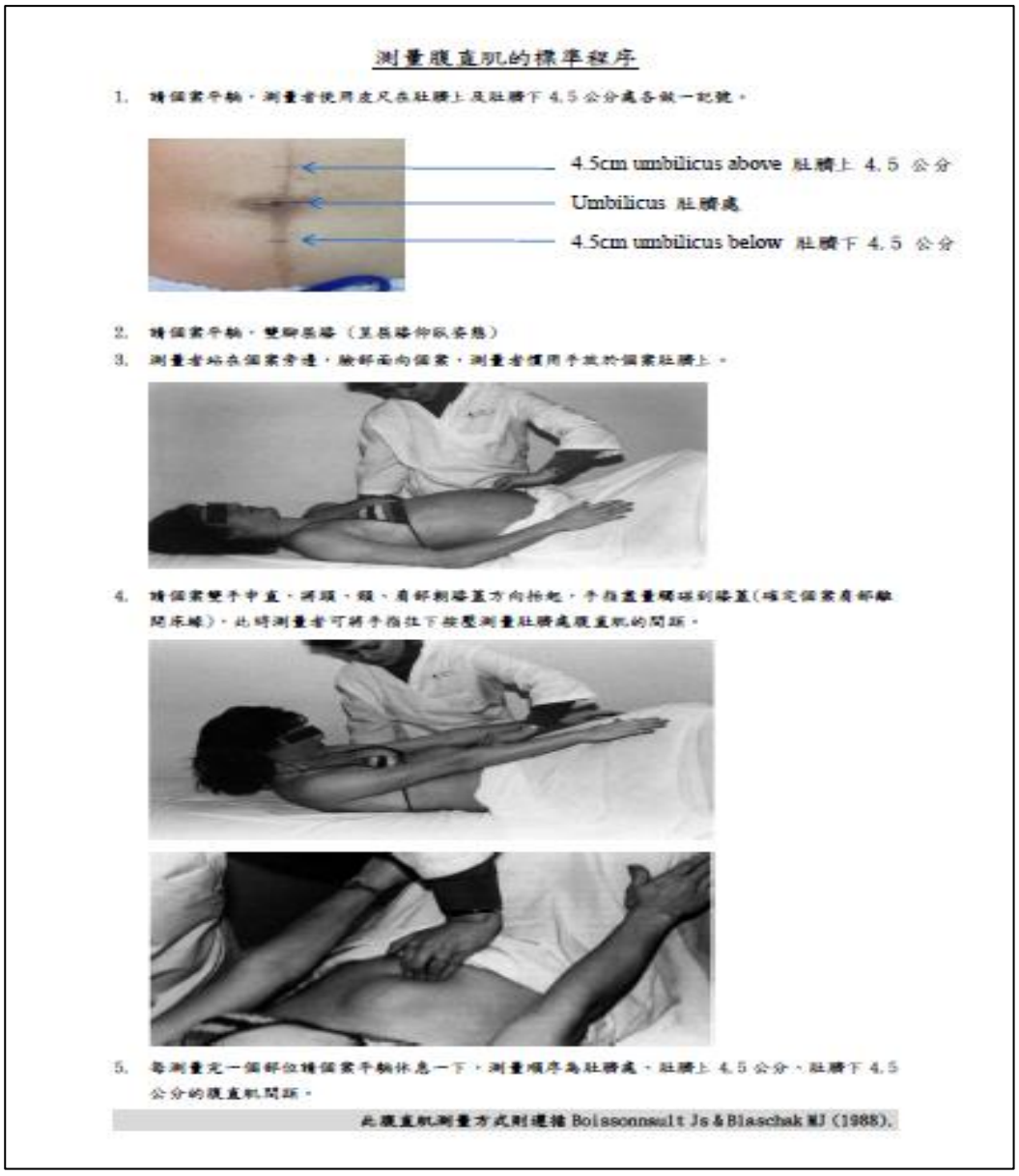


Figure 14: The Diastasis Recti test standardised process (Boissonnault and Blaschak, 1988)

4.4.11.4 Self-recording sheet

A self-recording sheet was given to all the participants to record daily exercise frequency, duration and method of exercise. The record sheet also provided space to record reasons if the exercise components were not followed as instructed (See Appendix 6).

4.4.11.5 Demographic questionnaire

The demographic questionnaire includes questions about age, marital status, height, weight, education, employment status, and details of any exercise activity before or during pregnancy (See Appendix 4).

4.5 Sample size determination

Statistical power analysis was calculated for the required sample size. The following assumptions were made for calculation of valid sample size based on the literature (Bhaumik et al., 2008; Dell and Ramakrishnan, 2002), assuming type I error= 0.05; with prior power set at 80% and referring to the VAS difference from prior RCTs on LLP research using the VAS as the primary measure for LLP (Mens et al., 2000), and followed Men's study, where the standard deviation (SD) between the three groups was specified as 1.6, whilst compliance was established as 80%. The sample size was estimated based on repeated measure ANOVA. By using G*Power statistical package (Germany; Version 3.1.1; Faul et al., 2007), assumptions were as follows: assuming medium effect size f = 0.25 (Potvin and Schutz, 2000), type 1 error= 0.05, statistical power = 0.8, with three groups and three repeated measures by using G*Power Version 3.1.1. The estimated sample size was 108. Taking into account the primipara caesarean section rate in Taiwan was 24.3% (the primipara caesarean section rate calculated by Shin Kong Medical Centre Hospital in 2014) and 26.1% refuse-to-participant rate (Stuge et al., 2004b). Therefore, this study needs to recruit 216 women. Each group needs to have 72 participants.

4.6 Data analysis

Two types of analyses were conducted: a) comparative analysis of the effectiveness of the three modes of instruction in terms of LPP, physical endurance and effect on waist circumference and diastasis recti and b) comparative analysis to assess the impact of the three modes of instruction on uptake, adherence and completion rates.

a) Comparative analysis of the effectiveness of the three modes of instruction in terms of LPP, physical endurance and effect on waist circumference and diastasis recti

LPP: The pain intensity rated on the VAS was achieved by measuring the distance in mm from the 0 point to the participant's mark on the VAS. For each group, median pain intensity was calculated.

Physical endurance: To analyse the DRI, every single item was assessed by measuring the distance in mm from the 0 point to the participant's mark on the VAS. The mean of the measurements provided the DRI index. A total DRI score was calculated by an average of 12 categorical variable scores, which was described as the median DRI for each group.

Physical examination: Waist circumference and diastasis recti were calculated as mean, standard deviation, and minimum and maximum values.

b) Comparative analysis to assess the impact of the three modes of instruction on uptake, adherence and completion rates

Exercise completion rate was calculated as a proportion of participants undertaking the exercises in the three groups.

Exercise adherence and uptake were calculated as mean, standard deviation, and minimum and maximum values.

c) All outcome measurements were analysed based on the intention to treat principle (ITT, data obtained for dropouts were included in the results). The intervention effectiveness was analysed using repeated measures ANOVA. To compare the effectiveness of the intervention between the three groups: DVD-based, Internet-based and Usual Care group, if continuous data satisfies the normality test, analysis of the multiple comparisons was used to test the between-group difference.

To compare the intervention groups (DVD-based and Internet-based), the fixed usual care group was employed as a reference and compared the DVD-based group with the Usual Care group, and the Internet-based group with the Usual Care group. The high possibility of a type I error with a relatively small sample size used the Dunette Post-hoc test. The significance level was corrected based on the Bonferroni correction method, which indicated multiple comparisons for three groups and that the significant level should be set as (0.05/3)=0.0168. All analyses were performed using SPSS for Windows 22.0.

4.7 Ethical issues

This study was approved by the Shin Kong Medical Centre Hospital Ethics Committee (approval number: 20141005R) in Taiwan (See Appendix 7) and by the Institute for Health Research Ethics Committee at the University of Bedfordshire (approval number: IHREC452) (See Appendix 8). Informed consent for participation in the study was obtained from all participants in accordance with the requirements of the ethics committees (See Appendix 9). All results were reported anonymously, with aliases being used to replace real identities, and

the results were available to all participants once the study was completed. All personal data recorded was kept confidentially in password-protected storage in the Department of Obstetrics and Gynaecology ward in Shin Kong Medical Centre Hospital. Participants also had the opportunity to contact the research team or administrators if they required further information or if they had a complaint or comment regarding the study. A favourable ethics opinion was received from both the ethics committee in Taiwan and the University of Bedfordshire Ethics Committee (20141005R and IHREC452).

Chapter 5

RESULTS OF SYSTEMATIC REVIEW OF RCTS ON THE EFFECTIVENESS OF EXERCISE ON LPP AMONG POSTNATAL WOMEN

This chapter presents the results of the systematic review that was conducted to develop an evidence base for the effectiveness of exercise interventions on postpartum LPP. This review follows the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) and has been submitted for publication. The review question was framed using PICO framework. The population comprised postnatal women who reported LPP onset either in pregnancy or within 3 months after delivery. The interventions consisted of physical therapy with an exercise programme. The comparators included no therapy or physical therapy using other methods, such as massage, relaxation, joint mobilisation, manipulation, electrotherapy, hot packs and simple muscle strengthening exercises. The primary outcome measure was changed in regard to LPP (See Chapter 3). A detailed account of the systematic review and the findings are reported in Tseng et al. (2015).

This review only considered RCTs. RCTs published between 1990 and 2014 were eligible for inclusion if the reported intervention comprised postnatal exercise for women who reported LPP onset during pregnancy or within 3 months after delivery, and the outcome measures included changes in LPP. A comprehensive search of the following databases was undertaken during February and March 2014 to identify relevant studies: PEDro, CINAHL, MEDLINE, PUBMED, SPORTDiscus. Other review data bases such as the Cochrane Central Register of Controlled trials, Cochrane Pregnancy and Childbirth Group's Trials Register, Centre for Reviews and Dissemination University of York, and electronic libraries of authors' institutions

were also searched. Additional sources included Google Scholar and the reference list of relevant articles and books. Key search terms were used for searches across all databases (See Chapter3). An updated search was completed in July 2014. The retrieved articles were scanned for relevance based on the title, abstract and full text.

5.1 Study selection

The results of the search and study selection are shown in Figure 15. The search process produced 1639 titles. 1278 records were retrieved after duplicates were removed. 756 were further excluded as these were not RCTs. The remaining 522 were exported to the reference software Mendeley and the titles and abstracts were screened. 60 articles were selected for full text screening. Following full text screening, 55 articles were excluded due to discordance with the inclusion criteria. Finally, five articles originating from four trials were included in the review as shown in Table 3.

The methodological quality assessment using the PEDro scale revealed a mean score of 6 (range = 4-8). Three trials (Mens et al., 2000; Stuge et al., 2004a; Gutke et al., 2010b) were found to be of 'good' methodological quality. Although one trial Chaudry et al., (2013) was rated as 'fair' with respect to the methodological quality, the reported information was not adequate to make a full assessment. This trial was included in the review based on the appropriateness of the study design and reported outcome measures. The results of the risk of bias assessment using the Cochrane tool are presented in Table 4. All the studies except one Chaudry et al. (2013) were at low risk of bias on key domains such as sequence generation, allocation concealment, blinding of participants and personnel, completeness of outcome data for each main outcome and selective reporting. In the trial conducted by Chaudry et al.

(2013), patients were reported to be randomly allocated, but the available information is largely insufficent to make a clear judgement on the other domains.

Although the interventions included exercise programmes, the components of the intervention, outcome measures, and follow up times were too diverse to allow a meta-analysis of the study findings. This was further confirmed by testing the homogeneity with the Meta-Analysis Add-In for Microsoft Excel software package (Kontopantelis and Reeves, 2009), and the heterogeneity using the I^2 test (Hinton and Olson, 2001) as follows:

$$\mathbf{I}^2 = 100 \times \frac{X^2 - df}{X^2}$$

The calculated I^2 value was 64%. Based on I^2 values, Higgins et al., (2003) classified heterogeneity as low (25%), moderate (50%), and high (75%). The calculated heterogeneity in the current review (64%) represented moderate to high heterogeneity. Hence, a narrative synthesis was undertaken.

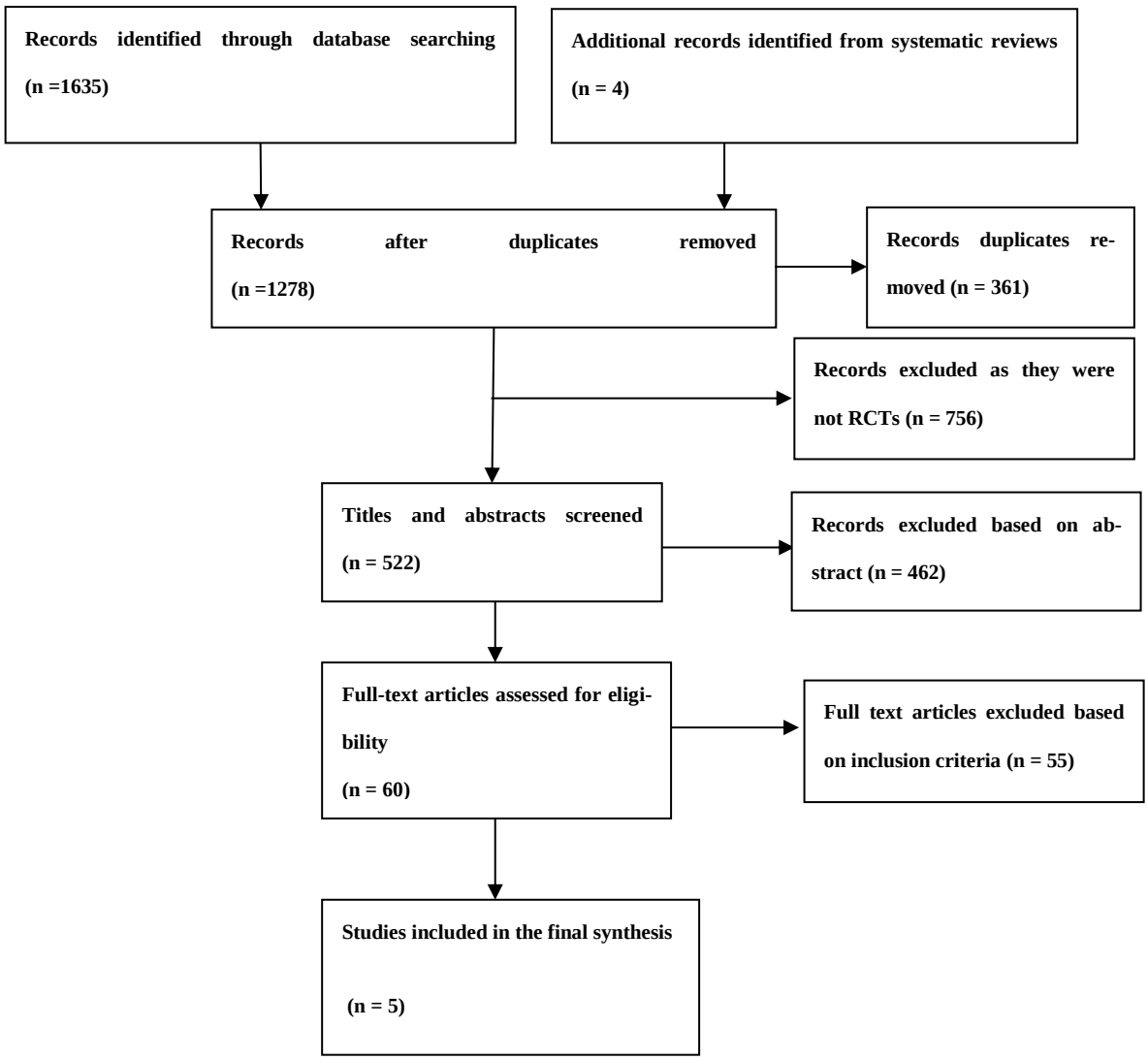


Figure 15: Study selection process (flowchart)

Table 3: Summary of study characteristics

Author/Publication year/country	Publication title	Design	Population/Sample	Quality rating
Mens et al., 2000 Netherlands	Diagonal Trunk Muscle Exercises in Peripartum Pelvic Pain: A Randomised Clinical Trial	Randomised controlled trial	Total : 44 women Intervention group:16 Control group 1: 14 Control group 2: 14	'Good'
Stuge et al., 2004a* Stuge et al., 2004b* Norway	The Efficacy of a Treatment Programme Focusing on Specific Stabilising Exercises for Pelvic Girdle Pain After Pregnancy: A Randomised Controlled Trial The Efficacy of a Treatment Programme Focusing on Specific Stabilising Exercises for Pelvic Girdle Pain After Pregnancy:	Randomised, single-blind, clinically controlled study with a stratified group design	Total: 81 women Intervention group: 40 Control group: 41 One year postpartum: Intervention group: 39 Control group: 39 Two years postpartum: Intervention group:30 Control group: 35	'Good'

Table 3: continued

	A Two-Year Follow-up of a Randomised Clinical Trial			
Gutke et al., 2010b Sweden	Specific muscle stabilising as home exercises for persistent pelvic girdle pain after pregnancy: a Randomised, Controlled Clinical Trial	Prospective, randomised, single-blinded clinically controlled study	Total: 86 Women Intervention group:32 3-month follow-up analysis (n = 26) 6-month follow-up analysis (n = 24) Control group: 54 3-month follow-up analysis (n = 39) 6-month follow-up analysis (n = 36)	'Good'
Chaudry et al., 2013 Pakistan	Effectiveness of core stabilisation exercises along with postural correction in postpartum back pain	A randomised controlled trial with non-probability sampling	Total: 40 women Intervention group:20 Control group: 20	'Fair'

*Both publications originated from the same trial

Table 4: Risk of bias

Domains	Risk of bias			
	Mens et al., 2000	Stuge et al., 2004a*; 2004b*	Gutke et al., 2010b	Chaudry et al., 2013
Random sequence generation	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Allocation concealment	Low risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias
Blinding of participants and personnel	Unclear risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias
Incomplete outcome data	Low risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias
Selective reporting	Low risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias
Other sources of bias	Low risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias

*Both publications originated from the same trial

5.2 Study characteristics

The study participants included 251 post-partum women reported in four trials who experienced LPP with onset either in pregnancy or within three months after child birth, as described in Table 3. The overall sample size in individual studies ranged from 40 (Chaudry et al., 2013) to 86 (Gutke et al., 2010b) with the size of the intervention group varying between 16 and 41 women (Mens et al., 2000; Stuge et al., 2004a). Two articles had originated from the same trial, reporting outcome measures at different intervals such as the week after the 18-20 week intervention, one year postpartum and two years postpartum (Stuge et al., 2004a, 2004b). One study divided participants into three groups: an experimental group with 16 postnatal women, and two control groups with 14 each (Mens et al., 2000). The included studies were from different countries: Netherlands (Mens et al., 2000), Norway (Stuge et al., 2004a, 2004b)., Sweden (Gutke et al., 2010b) and Pakistan (Chaudry et al., 2013).

The assessment data were collected at different time points such as baseline (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b; Chaudry et al., 2013), soon after intervention (Mens et al., 2000); at three and six months follow up (Gutke et al., 2010b); and at one and two years postpartum (Stuge et al., 2004a, 2004b). Only one trial assessed the long term effect of the intervention with outcomes reported at follow-up periods of one and two years (Stuge et al., 2004b). Additionally, one trial did not clearly report the time points when the assessment data was collected (Chaudry et al., 2013).

5.3 Interventions and comparators

The interventions consisted of various exercise programmes as presented in Table 5. Three trials used stabilisation exercise programmes as the intervention - either specific (Gutke et

al., 2010b) or core (Stuge et al., 2004a, 2004b; Chaudry et al., 2013), while the third trial used the diagonal trunk muscle systems training programme (Mens et al., 2000). The core stabilisation exercise programme used by Stuge et al. (2004a, 2004b) focused on training the deep local muscles (the transverse abdominal wall muscles with co-activation of the lumbar multifidus in the lumbosacral region) and global muscles (m. gluteus maximus, m. latissimus dorsi, the oblique abdominal muscles, m. erector spinae, m. quadratus lumborum, and hip adductors and abductors). The initial focus of this exercise was on specific contraction of the transverse abdominal muscles. In addtion to stabilisation exercises, postural correction techniques in different positions, such as supine, crook lying, half sitting and prone were also employed for the intervention group by Chaudry et al. (Chaudry et al., 2013). The specific stabilising exercises reported by Gutke et al. (2010b), focused on strengthening the transversely orientated abdominal, lumbar multifidus and the pelvic floor muscles, and on improving motor control and stability.

The interventions were varied in their frequency and duration. The frequency of the exercise ranged from ≥ 2 times per day (Gutke et al., 2010b), to three days per week week (Mens et al., 2000; Stuge et al., 2004a, 2004b). In one trial, the exact frequency of the exercise was not reported (Chaudry et al., 2013). In this trial, women in the treatment group were given three exercise sessions of half an hour during their stay in the hospital after birth. After discharge from the hospital, these women were called in for follow up sessions of 30 to 40 minutes treatment (Chaudry et al., 2013). The total reported duration of the intervention was between 8 weeks (Mens et al., 2000) and 20 weeks (Stuge et al., 2004a, 2004b) although this information was not available in the case of two trials (Gutke et al., 2010b; Chaudry et al., 2013). Co-interventions such as the use of a pelvic belt and pain medication were reported to be used for the experimental and control group in one trial (Mens et al., 2000). The

methods of delivering the interventions differed across trials and included a videotape with instruction of exercises to be performed at home without supervision (Mens et al., 2000); individualised exercise programmes performed primarily at home with guidance by the physical therapist, with adjustments performed once a week or fortnightly (Stuge et al., 2004a); home training with individual guidance and adjustment of the exercise programme every two weeks by one of two treating physiotherapists (Gutke et al., 2010b); and treatment sessions at the hospital (Chaudry et al., 2013). Compliance was measured using a training diary in two trials (Stuge et al., 2004a, 2004b; Gutke et al., 2010b) and a designated form in another one (Mens et al., 2000). This information was not available in one trial (Chaudry et al., 2013). The home-based approach in one trial was reported to be a barrier to control of compliance with diaries not handed in as expected (Gutke et al., 2010b). One trial reported high compliance with the treatment plan (Stuge et al., 2004a, 2004b). Compliance was not optimal in two trials (Mens et al., 2000; Gutke et al., 2010b). In one trial, 25% of the subjects in the experimental group stopped their exercise programme before the end of the study because of increased pain (Mens et al., 2000), and only 78% of the women in the treatment group reached stage 3 of the treatment programme in the other (Gutke et al., 2010b). No compliance information was reported in one trial (Chaudry et al., 2013).

The comparators included longitudinal trunk muscle systems training (Mens et al., 2000), simple back strengthening exercises (Chaudry et al., 2013); physical therapy using ergonomics, massage, joint mobilisation, manipulation, electrotherapy, hot packs (Stuge et al., 2004a, 2004b); or no exercise (Mens et al., 2000; Gutke et al., 2010b). Mens et al. (2000) included two comparison groups - one group with instructions to train the longitudinal trunk muscle system involving rectus abdominis muscle, longitudinal parts of the erector spinae muscle,

and the quadratus lumborum muscle, and the other instructed participants to refrain from exercise (Mens et al., 2000).

5.4 Outcomes

5.4.1 Primary outcome: changes in LPP

The outcomes reported in the trials are presented in Table 5. The primary outcome considered for this review is the change in LPP intensity among postnatal women at different follow up intervals. All the included trials reported changes in pain intensity and related variables as an outcome measure based on assessments using the VAS which is a uni-dimensional measure of pain intensity (McCormack et al., 1988). Pain intensity was assessed in the morning and in the evening in two trials as primary outcomes (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b); whereas current pain and average pain during the previous week were used as the measure in another trial (Gutke et al., 2010b). The latter trial also assessed pain frequency (always, day and night to several times per week, or occasionally to never) (Gutke et al., 2010b). Although VAS was reported to be used to measure pain intensity, the actual changes in pain intensity were unclear in one trial (Chaudry et al., 2013). Gluteal pain provoked by the PPPP test on the left and right sides was also reported as a secondary outcome in one trial (Mens et al., 2000).

In terms of the effectiveness of the exercise programme on LPP, one trial (Stuge et al., 2004a, 2004b) reported a significant positive effect on pelvic pain intensity as a result of the exercise. This trial found significant reductions in pain intensity in the morning and evening during the intervention period and at one and two year follow-ups, with a better reduction of pelvic girdle pain in the intervention group compared to the control group (Stuge et al.,

2004a, 2004b). The authors observed the greatest improvements in pain intensity during the intervention period of 20 weeks, with a further but slow improvement over the six months following treatment, which was also maintained two years after delivery. However, low levels of pain continued in the intervention group two years after delivery (Stuge et al., 2004a, 2004b). Although another trial reported significant improvements in back pain related variables such as restriction in Activities of Daily Livings (ADLs), and Instrumental Activities of Daily Livings (IADLs), changes in pain intensity were not reported as such (Chaudry et al., 2013).

Gutke et al. (2010b) reported significant differences in pain frequency between the intervention and control groups at three month follow-up in favour of the intervention group, but did not find any differences between the groups with respect to pain intensity, or other related variables such as Health Related Quality of Life (HRQDL) and wellbeing (Gutke et al., 2010b). Mens et al. (2000) did not find any significant difference with respect to the severity of pain in the morning and evening or related fatigue between the experimental group and both control groups (Mens et al., 2000). However, the intervention group scored better than the control groups with repect to changes in the Gluteal pain provoked by the PPPP test scores on the right side ($P<05$) (Mens et al., 2000). Within-group comparisons in three trials showed a decrease in LPP intensity and associated variables in both the experimental and control groups at different follow-up intervals compared to baseline (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b).

5.4.2 Other LPP related outcomes

A number of other LPP related outcome measures were also reported, as shown in Table 5. Two trials reported changes in functional status or disability measured using ODI (Stuge et al., 2004a, 2004b; Gutke et al., 2010b) and DRI (Stuge et al., 2004b). Stuge et al. (2004a,

2004b) reported significant improvements in functional status in the intervention group compared to the control group at one week after the intervention and at one and two years follow ups (Stuge et al., 2004a, 2004b). However, Gutke et al. (2010b) could not find any difference with respect to functional status between the two groups at three or six month follow-ups.

Changes in health-related quality of life in the intervention and control groups were reported in three trials using instruments such as the SF-36 Health survey (Stuge et al., 2004a, 2004b), EuroQol instrument (EQ-5D and EQ-VAS) (Gutke et al., 2010b), and Nottingham Health Profile (NHP) (Mens et al., 2000). Using the SF-36 Health Survey, Stuge et al. (2004a, 2004b), assessed health related quality of life at the time of entry, within one week after intervention and one and two years postnatal. On health related quality of life measurements, Stuge et al. (2004a), reported significant differences between the experimental and control groups in physical functioning, physical roles and body pain following the intervention and at one and two years after delivery (Stuge et al., 2004a, 2004b). Using NHP, Mens et al. (2000), reported overall improvement among study participants on the NHP pain scale at eight weeks intervention compared to the baseline, but could not find any statistically significant difference between the intervention and comparison groups (Mens et al., 2000). No differences were detected between the groups by Gutke et al. (2010b), on the EuroQol instrument (EQ-5D and EQ-VAS) on health-related quality of life (Gutke et al., 2010b) or wellbeing measured with VAS with defined end-points (low value indicating high wellbeing) (Gutke et al., 2010b).

Changes in physical mobility were reported by Mens et al. using radiographic examination to assess mobility of the pubic symphysis on left and right lower extremities at eight weeks af-

ter the intervention (Mens et al., 2000). Although there was an overall improvement in physical mobility among participants at eight weeks of intervention compared to baseline, there was no statistically significant difference between the experimental and comparison groups (Mens et al., 2000). A further study reported marked improvement in mobility dependence among the experimental group compared to the control group after following core stabilisation exercises and postural correction (Chaudry et al., 2013).

Changes in physical endurance were reported based on physical examinations and tests such as the Sorensen Test and ASLR test (Stuge et al., 2004a), and muscle function test (Gutke., 2010b). Stuge et al. (2004a), used the Sorensen Test and ASLR test at the time of entry, within one week after intervention and one year after delivery and found improvements in physical endurance with statistically significant differences between the groups in favour of the intervention (Stuge et al., 2004a). Gutke et al. (2010b), found a significant difference between the intervention and control groups for the mean hip extension remaining at three months follow-up. Within-group comparisons in the same study also showed improvements in both groups in several global muscles, though not in the pelvic floor muscles at three and six months follow-up compared to baseline (Gutke., 2010b).

Table 5: Summary of findings

Author/ Publication year	Intervention	Comparator	Intervention duration and frequency	Outcome measures	Effectiveness of the intervention (P<05)
Mens et al., 2000	Instructions given by videotape with training of the diagonal trunk muscles (n=16).	Comparator 1: Instructions given by videotape with training of the longitudinal trunk muscles (n=14). Comparator 2: Instructions given by videotape without exercises (n=14).	8-week duration. Light exercises to be performed 3 times per day and heavy exercises 3 times per week	Intensity of pain and fatigue in the morning and evening based on Visual Analogue Scale (VAS). Health-related quality of life (HQRL) based on Nottingham Health Profile (NHP). Gluteal pain provoked by the Posterior Pelvic Pain Provocation (PPPP) test on the left and right sides. Mobility of pubic symphysis (radiographic examination).	No significant differences in pain intensity, fatigue, HQRL, or mobility measures between the experimental group and both control groups. The experimental group scored better than the control groups with repect to gluteal pain provoked by the PPPP test on the right side.

Table 5: Continued

Stuge et al., 2004a* and Stuge et al., 2004b*	Physical therapy with specific stabilising exercises (n=40).	Physical therapy without specific stabilising exercises (n=41).	18 to 20 weeks duration. 3 days a week with a daily duration of 30 to 60 minutes	Pain intensity in the morning and evening based on VAS. Functional status (Oswestry LBP Disability Questionnaire). Health-related quality of life (SF-36 Health survey). Physical endurance (Sörensen Test, ASLR test).	After the intervention and 1 year follow up: Pain intensity in the morning and evening was significantly reduced in the intervention group. Functional status in the intervention group significantly better than the control group. Health-related quality of life shows significant improvement in the intervention group with largest effect in physical

Table 5: Continued

					function, role physical and bodily pain. Significant differences in functional status, evening pain, and morning pain between the groups were maintained 2 years after delivery. Health-Related Quality of Life at 2 years after delivery revealed that significant differences persisted between the groups in physical functioning, role physical and bodily pain. No significant differences

Table 5: Continued

					between the 2 groups were seen for the other 5 subscales (general health, vitality, social functioning, role emotional, and mental health).
Gutke et al., 2010b	Specific stabilising exercises focused on the transversely orientated	No exercise Instructed to resume normal activities.	Total duration not reported. ≥ 2 times per day and to perform each exercise with 10 repetitions.	Disability based on the Oswestry Disability Index (ODI) version 2.0. Pain intensity measured with VAS (0–100 mm) for current pain and average pain during	For ODI, no difference could be demonstrated between the intervention and control groups at 3- or 6-month follow-up. Significant difference in

Table 5: Continued

	abdominal, the lumbar multifidus, and the pelvic floor muscles.			the previous week. Pain frequency (always, day and night to several times per week, or occasionally to never). Health related quality of life (HRQL) measured using EuroQol instrument (EQ-5D and EQ-VAS). Wellbeing measured with VAS (0-100 mm) with defined endpoints (low value indicating high wellbeing).	pain frequency was demonstrated between the two groups at the 3-month follow-up in favour of the intervention group. No differences could be found between the groups regarding pain intensity, HRQL or wellbeing.

Table 5: Continued

Chaudry et al., 2013	Core stabilisation exercises along with postural correction in different positions.	Simple back strengthening exercises in different positions.	Total duration not reported. 3 sessions of half an hour during the stay in hospital.	Back pain (Visual analogue scale VAS). Activities of Daily Livings (ADLs) and Instrumental Activities of Daily Livings (IADLs) Mobility (dependent and independent). Muscles power. Manual Muscle Testing (MMT). Pedal edema.	Significant improvement in ADLs and IADLs in intervention group compared to control group. Significant improvement in muscle power in intervention group compared to control group. Significant improvement in mobility in intervention group compared to control group.

Table 5: Continued

					Intervention group showed improvement in edema compared to control group, but p-value was insignificant.

*Both publications originated from the same trial

5. 5 Mode of delivering the interventions

The methods of delivering the interventions differed across trials and included a videotape with instruction of exercises to be performed at home without supervision (Mens et al., 2000); individualised exercise programme performed primarily at home with guidance by the physical therapist with adjustments performed once a week or fortnightly (Stuge et al., 2004a, 2004b); home training with individual guidance and adjustment of the exercise programme every two weeks by one of two treating physiotherapists (Gutke., 2010b); and treatment sessions at the hospital (Chaudry et al., 2013). Compliance was measured using a training diary in two trials (Stuge et al., 2004a, 2004b; Gutke., 2010b) and a designated form in another one (Mens et al., 2000). This information was not available in one trial (Chaudry et al., 2013). The home-based approach in one trial was reported to be a barrier to control compliance with diaries not handed in as expected (Gutke., 2010b). One trial reported high compliance with the treatment (Stuge et al., 2004a, 2004b). Compliance was less optimal in two trials (Mens et al., 2000; Gutke., 2010b). In one trial, 25% of the subjects in the experimental group stopped their exercise programme before the end of the study because of increase in pain (Mens et al., 2000) and only 78% of the women in the treatment group reached stage 3 of the treatment programme in the other (Gutke., 2010b). No compliance information was reported in one trial (Chaudry et al., 2013).

5.6 How the results of the systematic review informed the PRCT in phase 2

The systematic review (first phase of this study), aimed to develop an evidence base for the effectiveness of exercise interventions on postpartum LPP. Four trials pertaining to RCTs design (five articles in total) were found. Interventions in the four trials used specific or core

stabilisation exercise programmes and diagonal trunk muscle systems training programmes. The systematic review findings confirmed that certain exercise interventions had a significant influence on the LLP in the postpartum period. The review also showed that there is extremely little or no evidence on the effectiveness of various mediums of exercise delivery for postnatal women with LPP. This information was used as the basis for conceptualising the PRCT in phase 2.

The systematic review also offered valuable information in relation to the research methodology including the study design, sample size and response rates for designing the PRCT. The design of the PRCT was similar to three-armed randomised controlled trial (Mens et al., 2000) included in the systematic review, although three-armed RCT was designed as an experiment with high internal validity with the ability to determine cause-effect relationships. Moreover, RCTs in general employ comprehensive designs to control sources of bias by means of randomisation, blinding, allocation concealment and experiment group described the trials that aim to evaluate the efficacy of an intervention in an explicit, controlled setting.

The sample size calculations in the four trials included in the systematic review were useful to derive sample size estimates for the current PRCT. The overall sample size in the individual studies ranged from 40 (Chaudry et al., 2013) to 86 (Gutke et al., 2010b). The response rates in the five articles were exceedingly high and ranged from 68 (Gutke et al., 2010b) to 100% (Mens et al., 2000; Chaudry et al., 2013). The loss rates were reported to be 3% (Stuge et al., 2004a), 26.1% (Stuge et al., 2004b) and 32% (Gutke et al., 2010b). These numbers were used in deriving sample size estimates for the current PRCT.

The choice of the measurement tool for the main outcome (changes in LPP) was also informed by the systematic review. The VAS measurement tool was employed to assess pain

intensity in the four trials, including pain intensity in the morning and in the evening (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b); and current pain and average pain during the previous week (Gutke et al., 2010b). As VAS was the sole measurement tool used in all the trials, VAS was selected as a measurement tool for the current PRCT.

Chapter 6

RESULTS OF PRAGMATIC TRIAL TO ASSESS THE EFFECTIVENESS AND ACCEPTABILITY OF AN EXERCISE PROGRAMME DELIVERED USING DIGITAL DVD, INTERNET OR LEAFLET (USUAL CARE), ON LPP AMONG POSTNATAL WOMEN

6.1 Introduction to PRCT results

Using the methodology described in Chapter 4, a pragmatic, randomised controlled trial was undertaken with the aim of assessing the acceptability and effectiveness of DVD and Internet-based exercise interventions on postpartum LPP in Taiwanese women, in comparison to the usual intervention by means of leaflets. This section presents the results in relation to Objectives 2 and 3 (see Chapter 1), where data were summarised as the mean and standard deviation for continuous variables and as proportions for categorical variables. The continuous variables were analysed using one-way ANOVA, whereas the categorical variables were analysed using the Chi-square test to compare the groups' initial differences. The follow-up results were analysed using repeated measures ANOVA to compare differences between groups and times (pre-intervention: discharge; after intervention: six weeks and four months). Additionally, the Usual Care group was set as the reference group, compared with the DVD-based group and Internet-based group. The level of significance was set as two-tailed 0.05, the Post Hoc test used Dunnett's t-tests to determine the statistical significance between groups. The significance level will be corrected based on Bonferroni correction method, which indicated that multiple comparisons for three groups, the significant level needs to be set as (0.05/3)=0.0168.

6.2 Results of participants recruitment

The enrolment of participants took place between March 2015 and June 2016. 315 nulliparous women were assessed for eligibility. 92 women were excluded from participating based on inclusion criteria, the reason being not feeling LPP during pregnancy (n =59), spinal problems before pregnancy (n=5) and declined to participate (n=28). In total, 213 healthy nulliparous women were included in weeks 34 to 41 of pregnancy and randomly allocated to the DVD-based group (n=71), Internet-based group (n=71) and the Usual Care group (n=71). 213 participants were waiting for delivery and received intervention, after childbirth some participants (n=55) did not continue with the study for several reasons, such as caesarean section (n=50), refusal (n=2) and birth place not in study setting (n=3). 158 participants met the inclusion criteria and were enrolled in the study. From the original participant sample, 16 participants were removed from the DVD-based group, 23 participants from the Internet-based group and 16 participants from the Usual Care group, yielding an attrition rate of 25.82%. As a result, the study included 55 participants in the DVD-based group, 48 participants in the Internet-based group and 55 in the Usual Care group (Figure 16).

During the six-week follow-up process, 128 participants responded to the questionnaires, though some participants (n=30) were removed from the study since they had no time to return to the hospital for follow-up. The loss rate was 18.98% at this phase. During the four months' follow-up, a further 23 participants refused to continue with the study, which incurred a loss rate of 17.96%. At the end, a total of 105 participants completed the data exercise and made the completion rate of 49.29% (Figure 16, Table 6).

Table 6: Summary of follow-up rates in three groups

	All	DVD-based	Internet-based	Usual care
	N (%)	N (%)	N (%)	N (%)
During pregnancy	213 (100)	71 (100)	71 (100)	71 (100)
Discharge	158 (74.18)	55 (77.46)	48 (67.6)	55 (77.46)
Six weeks postpartum	128 (60.09)	43 (60.56)	42 (59.15)	43 (60.56)
Four months postpartum	105 (49.29)	35 (49.29)	32 (45.07)	38 (53.52)

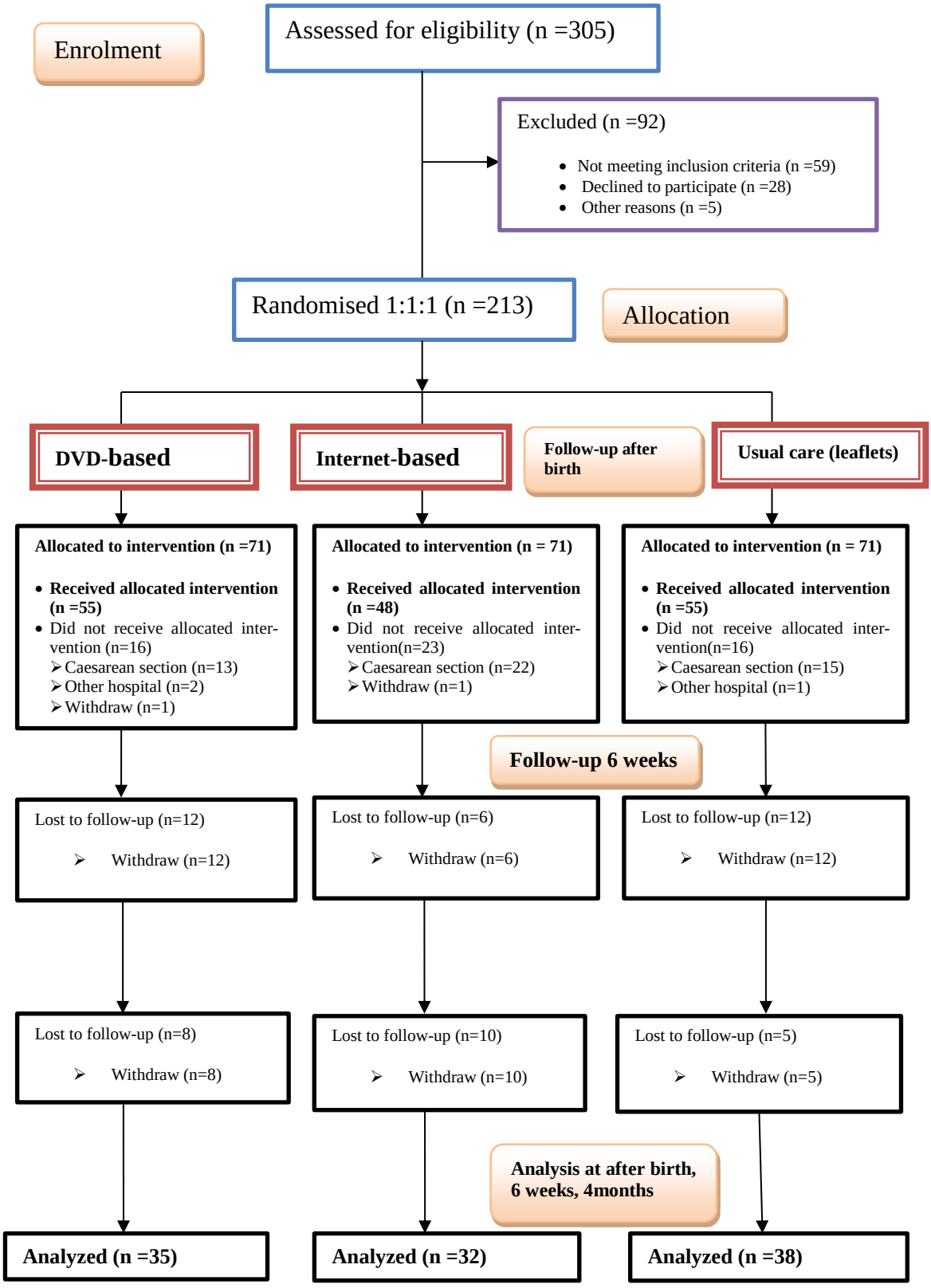


Figure 16: Procedures for selection and follow-up of participants

6.3 Biographical and Socio-demographic characteristics of the participants at recruitment

A total of 213 participants were recruited into the study. The continuous variables were compared using the mean ($\bar{x}$), standard deviation (SD) and minimum to maximum were expressed, and the categorical variables using Chi-square statistics presented as proportion of numbers and percentage. The age, height, body weight, BMI and gestation week were included in the biographical profile. Education, marital status, employment status and exercise behaviours before and during pregnancy formed part of the demographic characteristics of the study population are shown in Table 7 and Table 8.

The results of the biographical analysis demonstrated the mean age of participants in the DVD-based group as 31.4 years old (range from 18-40.4) compared to 31.0 years old (range from 18-40.5) in the Internet-based group and 32.0 years old (range from 20.6-40) in the Usual Care group. The mean heights of the three groups were 160.4cm, 160.0cm and 159.9cm, and weights 67.2kg, 68.8kg and 67.6kg respectively. The mean of the gestation week in the DVD-based group was 36.6 weeks compared to 36.2 weeks in the Internet-based group and 36.6 weeks in the Usual Care group. The mean of BMIs at recruitment of the groups were 26.1kg/m2, 26.5kg/m2 and 26.4kg/m2. BMIs before pregnancy were 20.8kg/m2, 21.8kg/m2 and 21.2kg/m2 respectively. The p-value comparison among the three groups indicated no significant difference (see Table 7).

The results of the demographic analysis demonstrated that more than half of the participants had a bachelor's degree (57.7%) and 97.7% of the women were married. 72.3% were employed full time and 23.9% were unemployed. 54.5% (n=116) reported exercising before pregnancy. The exercise before pregnancy chosen by most of the women was to take a walk

every day for at least 30 minutes (n=42, 36.2%), gym (n=16, 13.7%), aerobic exercise (n=15, 12.9%), yoga (n=13, 11.2%), swimming (n=10, 8.6%) and running (n=9, 7.7%). 55.4% of women (n=118) reported exercising during pregnancy. The type of exercise during pregnancy included a daily walk of a minimum of 30 minutes (n=96, 81.3%), yoga (n=14, 11.8%) and going to the gym (n=3, 2.5%). There were no significant differences noted in the results from these three groups (see Table 8).

Table 7: Biographical profile of women per group (n=213)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	P-value*
Age (years)	31.5 (4.8)	18-40.5	31.4 (4.9)	18-40.4	31.0 (5.1)	18-40.5	32.0 (4.3)	20.6-40	0.453
Height (cm)	160.1 (5.1)	149-175	160.4 (4.8)	150-171	160.0 (5.3)	150-175	159.9(5.4)	149-172	0.857
weight (Kg)	67.8 (10.1)	45-113.4	67.2 (7.9)	49-86	68.8 (12.3)	51.5-113.4	67.6 (9.6)	45-95.4	0.627
Gestation week	36.5 (1.6)	34-40.5	36.6 (1.4)	34.1-40.5	36.2 (1.6)	34-40	36.6 (1.6)	34-39.5	0.272
BMI at recruitment	26.3 (3.7)	13.3-41.5	26.1 (3.0)	20.4-33.5	26.5 (4.5)	13.3-41.1	26.4 (3.5)	18.7-36.1	0.762
BMI before pregnancy	21.3 (3.1)	15.7-35.3	20.8(2.6)	15.7-28.2	21.8 (3.6)	15.8-35.3	21.2 (3.0)	15.9-30.8	0.166

*One-way ANOVA

Table 8: Demographical profile of women per group (n=213)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)	p-value 1
Education					0.154
Secondary school	2 (0.9)	1 (0.5)	1 (0.5)	–	
High school	39 (18.3)	8 (3.8)	15 (7)	16 (7.5)	
College	32 (15.0)	9 (4.2)	8 (3.8)	15 (7.0)	
Bachelor's degree	123 (57.7)	49 (23)	38 (17.8)	36 (16.9)	
Master's degree	17 (8.0)	4 (1.9)	9 (4.2)	4 (1.9)	
Marital status					0.238
Single	5 (2.3)	2 (0.9)	3 (1.4)	–	
Married	208 (97.7)	69 (32.4)	68 (31.9)	71 (33.3)	
Employment Status					0.680
Fulltime	154 (72.3)	48(22.5)	51 (23.9)	55 (25.8)	
Part time	8 (3.8)	4 (1.9)	2 (0.9)	2 (0.9)	
Unemployed	51 (23.9)	19 (8.9)	18 (8.5)	14 (6.6)	
Exercise Before Pregnancy					0.698
Yes	116(54.5)	39 (18.3)	41 (19.2)	36 (16.9)	
No	97 (45.5)	32 (15.0)	30 (14.1)	35 (16.4)	
Exercise During Pregnancy					0.781
Yes	118 (55.4)	41 (19.2)	40 (18.8)	37 (17.4)	
No	95 (44.6)	30 (14.1)	31 (14.6)	34 (16.0)	
Type of exercise before pregnancy					0.798
To take a walk over 30 minutes per day	42 (36.2)	13 (11.2)	15 (12.9)	14 (12.0)	
Brisk walking	8 (6.9)	2 (1.7)	2 (1.7)	4 (3.4)	
Yoga	13 (11.2)	4 (3.4)	7 (6.0)	2 (1.7)	
Aerobic exercise	15 (12.9)	7 (6.0)	4 (3.4)	4 (3.4)	
Swim	10 (8.6)	4 (3.4)	4 (3.4)	2 (1.7)	
Gym	16 (13.7)	5 (4.3)	6 (5.1)	5 (4.3)	
Ball exercise	3 (2.5)	2 (1.7)	1 (0.8)	–	
running	9 (7.7)	2 (1.7)	2 (1.7)	5 (4.3)	

Table 8: continued

Type of exercise during pregnancy					0.646
To take a walk over 30 minutes per day	96 (81.3)	30 (25.4)	33 (27.9)	33 (27.9)	
Brisk walking	2 (1.6)	1 (0.8)	1 (0.8)	–	
Yoga	14 (11.8)	6 (5.0)	5 (4.2)	3 (2.5)	
Aerobic exercise	1 (0.8)	1 (0.8)	–	–	
Gym	3 (2.5)	2 (1.6)	1 (0.8)	–	
Ball exercise	2 (1.6)	1 (0.8)	–	1 (0.8)	

1Chi-square test

6.4 Pregnancy-related LPP at recruitment

This section will include the pain LPP related measurements at recruitment including the pain intensity participants felt at that specific time (present) and in the 'past week', as well as LLP of pain levels, pain areas and pain sensations. LPP was assessed by the VAS. The scale was 0 mm (no pain) to 100mm (worst imaginable pain) (Huskisson, 1974; Myles et al., 1999; Johnson, 2006; Hawker et al., 2011). At recruitment, participants were asked to report 'current' pain intensity and pain intensity 'in the 'past week'' by placing a perpendicular line on the VAS line at the point. The mark point represents their pain intensity. Additionally, they were also asked to mark the initial pain intensity at the onset of LPP. The analysis of pain intensity was performed using one-way ANOVA to compare mean ($\bar{x}$) and standard deviation for the three groups. Pain intensity levels followed the scale line of meaning 0-4mm of no pain, 5-44mm of mild pain, 45-74mm of moderate pain and 75-100mm of severe pain (Jensen et al., 2003).

6.4.1 Pain intensity at recruitment

For LPP during pregnancy, 213 of the women responded with the pain intensity of pain at first time, present and 'past week'. 157 participants (73.7%) had pain at the current time. The mean value of pain at first time was reported as 44.0mm in the DVD-based group, 40.9mm in the Internet-based group and 42.6mm in the Usual Care group. The mean value of pain scale 'at present' demonstrated 27.3mm in the DVD-based group, 27.7mm in the Internet-based group and 22.0mm in the Usual Care group. Pain intensity of the 'past week' was reported as 46.7mm in the DVD-based group, 45.4mm in the Internet-based group and 49.0mm in the Usual Care group. There were no significant differences noted in the results

for LPP during pregnancy (see Table 9; Figure 17). Pain intensity levels during pregnancy indicated that 57.6% were in mild pain and 39.2% in moderate pain at the first time, 53.2% in mild pain and 38.6% in moderate pain in the 'past week', and 32.3% in mild pain and 24.7% in moderate pain 'at present' (see Table 10; Figure 18).

Table 9: VAS in mm (0-100) of LPP during pregnancy for three groups (at recruitment) (n=213)

	All		DVD-based (n=71)		Internet-base (n=71)		Usual care (n=71)		
Characteristic	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	P-value*
Lumbopelvic pain during pregnancy									
Pain at first time	42.5 (14.9)	15-90	44.0 (16.8)	15-90	40.9 (14.0)	18-80	42.6 (13.9)	20-80	0.459
Pain 'at present'	25.7 (25.6)	0-90	27.3 (25.2)	0-80	27.7 (28.6)	0-90	22.0 (22.5)	0-80	0.332
Pain at 'past week'	47.0 (16.6)	30-90	46.7 (15.3)	30-90	45.4 (17.0)	30-80	49 (17.4)	30-90	0.443

*One-way ANOVA

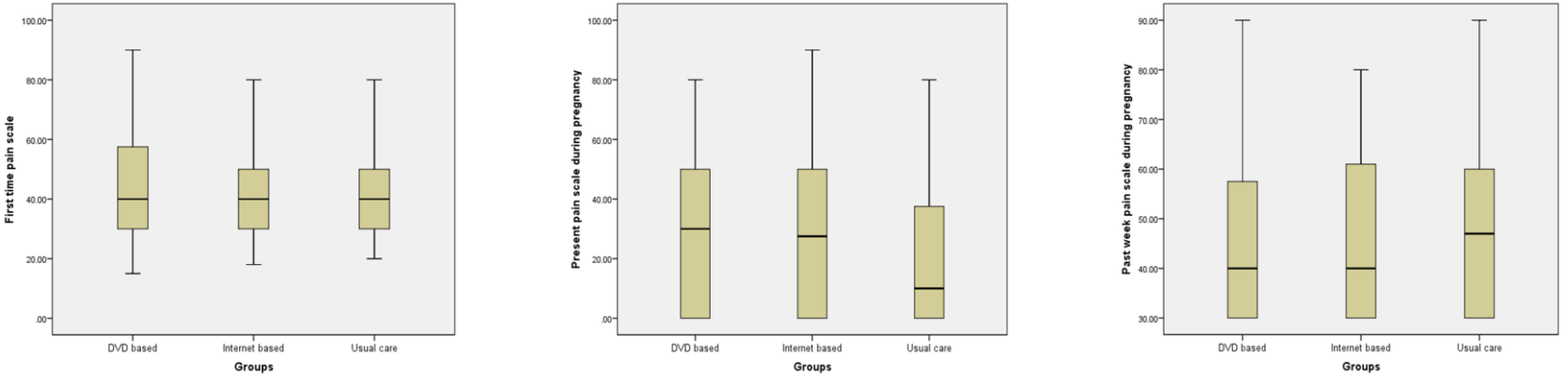
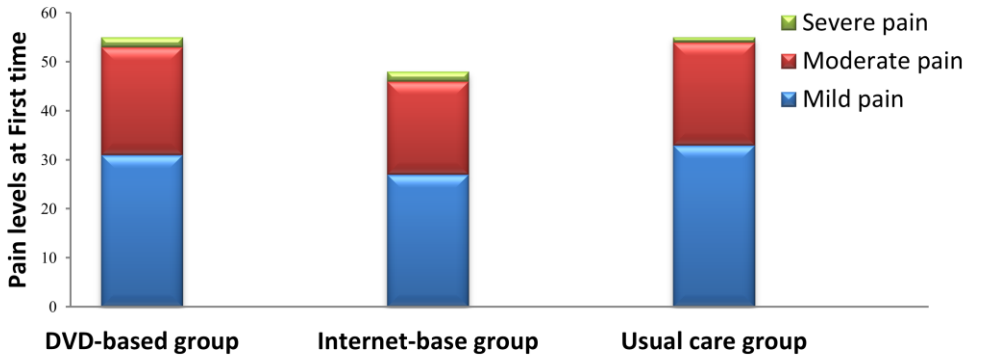
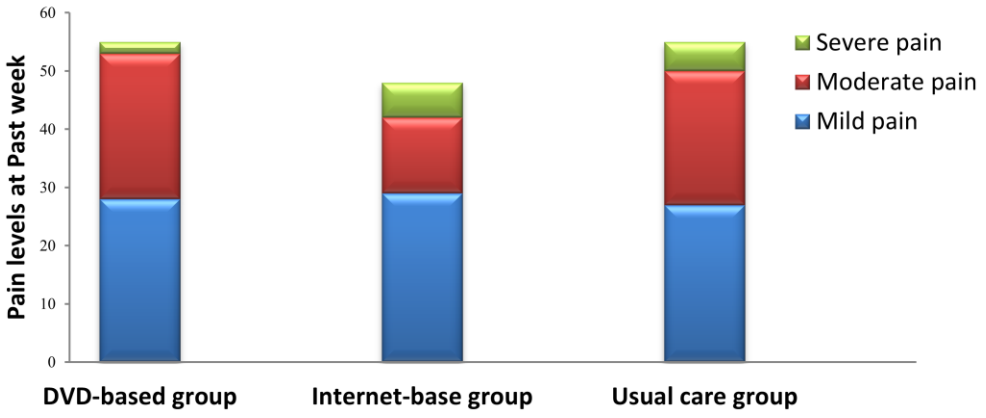


Figure 17: Median (minimum–maximum) pain intensity in mm during pregnancy (at recruitment) (0–100 mm)

Table 10: LPP levels during pregnancy for three groups (at recruitment) (n=213)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)
Pain at first time				
Mild pain	91 (57.6)	31 (19.6)	27 (17.1)	33 (20.9)
Moderate pain	62 (39.2)	22 (13.9)	19 (12.0)	21 (13.3)
Severe pain	5 (3.2)	2 (1.3)	2 (1.3)	1 (0.6)
At 'past week'				
Mild pain	84 (53.2)	28 (17.7)	29 (18.4)	27 (17.1)
Moderate pain	61 (38.6)	25 (15.8)	13 (8.2)	23 (14.6)
Severe pain	13 (8.2)	2 (1.3)	6 (3.8)	5 (3.2)
'at present'				
No pain	60 (38.0)	17 (10.8)	19 (12.0)	24 (15.2)
Mild pain	51 (32.3)	18 (11.4)	12 (7.6)	21 (13.3)
Moderate pain	39 (24.7)	18 (11.4)	12 (7.6)	9 (5.7)
Severe pain	8 (5.1)	2 (1.3)	5 (3.2)	1 (0.6)





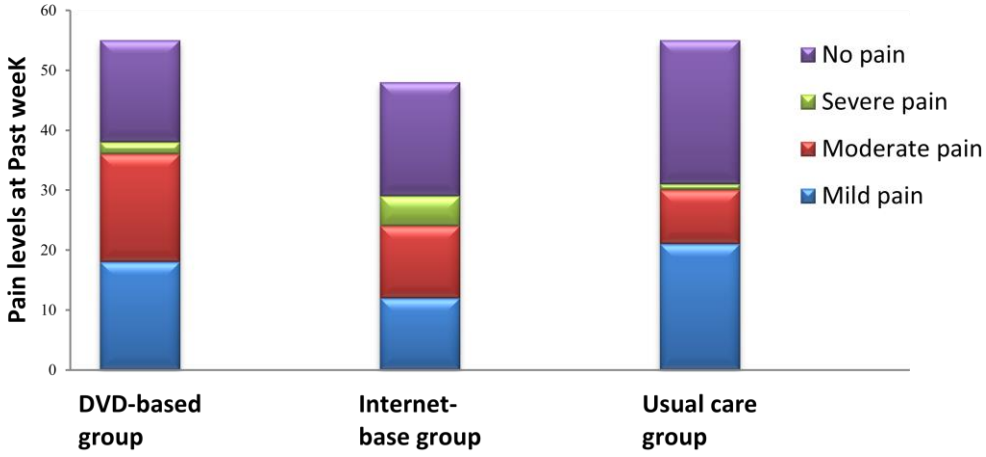


Figure 18: LPP levels during pregnancy at recruitment

6.4.2 Pain areas and pain sensations at recruitment

Pain areas were defined on the lower back, anterior pelvis and posterior pelvic area. Most of the pain areas were described on the lower back. Women's experience of the first time pain area was 60.1% on the lower back (DVD-based group: 19.2%, Internet-based group: 22.1%, Usual Care group: 22.1%), 12.7% in the posterior pelvic area (DVD-based group: 3.3%, Internet-based group: 6.1%, Usual Care group: 3.3%), 9.4 % in the anterior pelvic area (DVD-based group: 3.8%, Internet-based group: 2.8%, Usual Care group: 2.8%), and the number of participants who complained of pain in the combined areas were 8.5% on the lower back and posterior pelvic area (DVD-based group: 2.3%, Internet-based group: 2.8%, Usual Care group: 3.3%), and 7.5% on the lower back and anterior pelvic areas (DVD-based group: 3.3%, Internet-based group: 2.3%, Usual Care group: 1.9%). In the 'past week', almost half of the participants experienced lower back pain (49.8%) (DVD-based group: 14.6%, Internet-based group: 16.4%, Usual Care group: 18.8%) and 16.9% of women had posterior pelvic pain (DVD-based group: 3.8%, Internet-based group: 6.1%, Usual Care group: 7.0%). For current pain experience, the areas of pain were on the lower back (30.5%) (DVD-based group: 10.8%, Internet-based group: 11.3%, Usual Care group: 8.5%) and anterior pelvic area (10.3%) (DVD-based group: 2.8%, Internet-based group: 2.3%, Usual Care group: 5.2%). There was no significant difference in the pain area for the three groups (see Table 11; Figure 19).

Participants first reported LPP the first time during pregnancy. For 53.5% of women, this was between 29-36 gestational weeks (DVD-based group: 17.8%, Internet-based group: 17.4%, Usual Care group: 18.3%), for 34.3% it was between 13-28 gestational weeks (DVD-based group: 11.7%, Internet-based group: 11.7%, Usual Care group: 10.8%) and for 12.2% it was during the first 12 weeks or earlier (DVD-based group: 3.8%, Internet-based group: 4.2%,

Usual Care group: 4.2%). The types of pain sensation were described as dull, aching numbness, stabbing, tingling, cramping and burning. The most frequent pain sensations were indicated as aching pain and stabbing pain. The percentage of aching pain and stabbing pain reported was 84.5% (aching pain: DVD-based group: 25.8%, Internet-based group: 28.6%, Usual Care group: 30%) and 15.5% (stabbing pain: DVD-based group: 7.0%, Internet-based group: 3.8%, Usual Care group: 4.7%) at the first occurrence. 80.3% reported aching pain (DVD-based group: 25.8%, Internet-based group: 27.7%, Usual Care group: 26.8%) and 19.2% reported stabbing pain (DVD-based group: 7.5%, Internet-based group: 5.2%, Usual Care group: 6.6%) during the 'past week'. The percentage of pain sensation 'at present' involved 48.8% in the aching pain category (DVD-based group: 16.9%, Internet-based group: 16%, Usual Care group: 16%) and 10.8% in the stabbing pain category (DVD-based group: 3.8%, Internet-based group: 3.3%, Usual Care group: 3.8%). There was no significant difference in the pain sensation of the three groups (see Table 12).

Table 11: Area of LPP distribution during pregnancy (at recruitment) (n=213)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)	P-value 1
LPP location during pregnancy					
First time					
Lower back	128 (60.1)	41 (19.2)	40 (22.1)	47 (22.1)	0.688
Anterior pelvic	20 (9.4)	8 (3.8)	6 (2.8)	6 (2.8)	0.434
Posterior pelvic	27 (12.7)	7 (3.3)	13 (6.1)	7 (3.3)	0.535
Lower back and Anterior pelvic	16 (7.5)	7 (3.3)	5 (2.3)	4 (1.9)	0.409
Lower back and Posterior pelvic	18 (8.5)	5 (2.3)	6 (2.8)	7 (3.3)	0.841
Anterior pelvic and Posterior pelvic	4 (1.9)	3 (1.4)	1 (0.5)	-	0.355
At ‘past week’					
Lower back	106 (49.8)	31 (14.6)	35 (16.4)	40 (18.8)	0.452
Anterior pelvic	27 (12.7)	13 (6.1)	7 (3.3)	7 (3.3)	0.106
Posterior pelvic	36 (16.9)	8 (3.8)	13 (6.1)	15 (7.0)	0.205
Lower back and Anterior pelvic	22 (10.3)	10 (4.7)	6 (2.8)	6 (2.8)	0.446
Lower back and Posterior pelvic	15 (7.0)	5 (2.3)	8 (3.8)	2 (0.9)	0.116
Anterior pelvic and Posterior pelvic	7 (3.3)	4 (1.9)	2 (0.9)	1 (0.5)	0.632
‘at present’					
Lower back	65 (30.5)	23 (10.8)	24 (11.3)	18 (8.5)	0.835
Anterior pelvic	17 (8.0)	9 (4.2)	4 (1.9)	4 (1.9)	0.494
Posterior pelvic	22 (10.3)	6 (2.8)	5 (2.3)	11 (5.2)	0.424
Lower back and Anterior pelvic	17 (8.0)	6 (2.8)	6 (2.8)	5 (2.3)	0.574
Lower back and Posterior pelvic	7 (3.3)	2 (0.9)	2 (0.9)	3 (1.4)	0.948
Anterior pelvic and Posterior pelvic	3 (1.4)	1 (0.5)	1 (0.5)	1 (0.5)	0.681

1Chi-square test

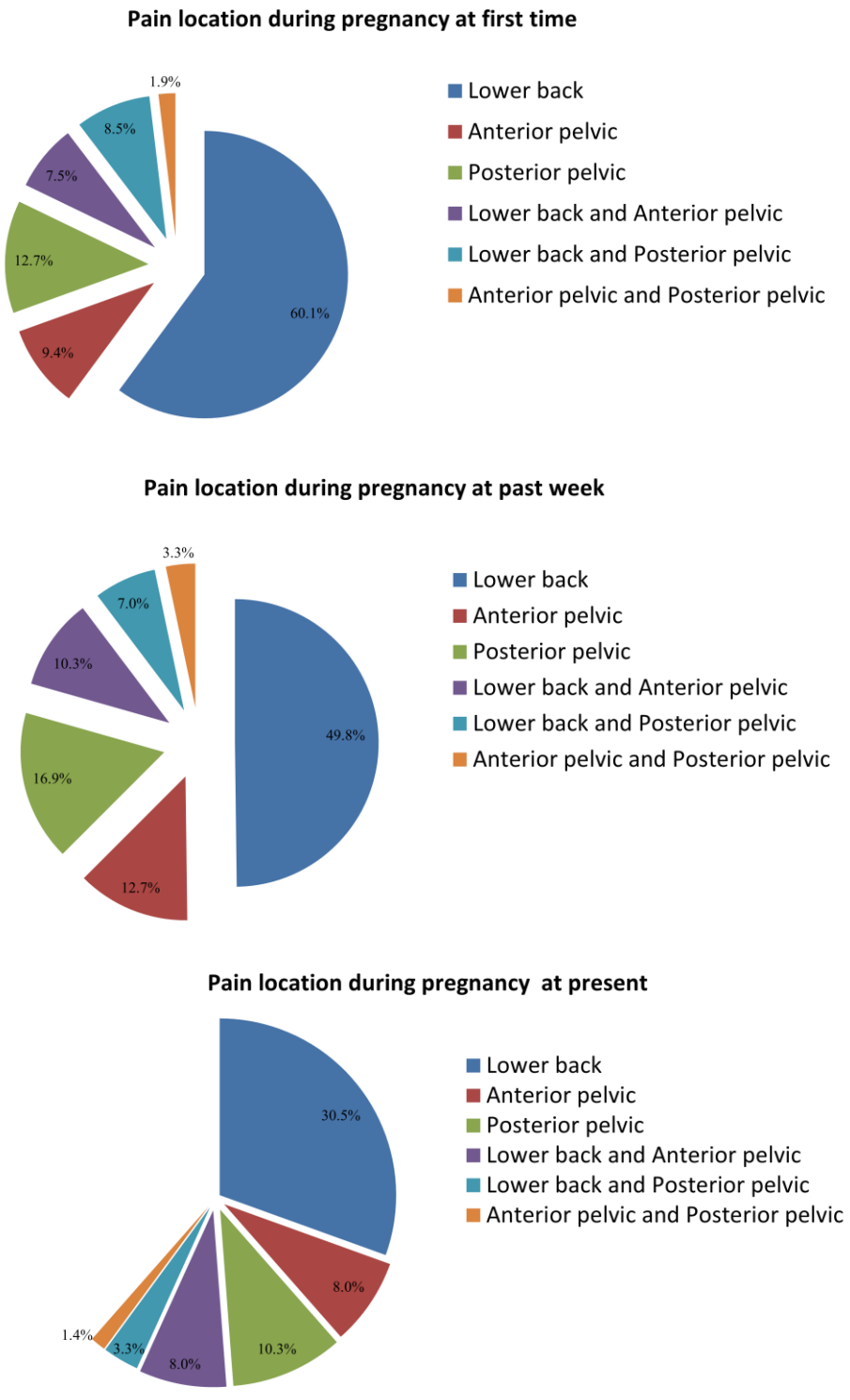


Figure 19: LPP location during pregnancy at recruitment

Table 12: Pain sensation during pregnancy per group (at recruitment) (n=213)

Characteristics	All	DVD-based	Internet-base	Usual care	P-value1
	N (%)	N (%)	N (%)	N (%)	
Gestational week of LPP at first time					0.993
12 weeks and less	26 (12.2)	8 (3.8)	9 (4.2)	9 (4.2)	
13-28 weeks	73 (34.3)	25 (11.7)	25 (11.7)	23 (10.8)	
29-36 weeks	114 (53.5)	38 (17.8)	37 (17.4)	39 (18.3)	
LPP experience during pregnancy First time					
Dull Pain	15 (7.0)	5 (2.3)	4 (1.9)	6 (2.8)	0.806
Aching Pain	180 (84.5)	55 (25.8)	61 (28.6)	64 (30.0)	0.104
Numbness Pain	11 (5.2)	3 (1.4)	2 (0.9)	6 (2.8)	0.288
Stabbing Pain	33 (15.5)	15 (7.0)	8 (3.8)	10 (4.7)	0.247
Tingling Pain	7 (3.3)	3 (1.4)	1 (0.5)	3 (1.4)	0.554
Cramping Pain	6 (2.8)	3 (1.4)	2 (0.9)	1 (0.5)	0.598
Burning Pain	1 (0.5)	-	1 (0.5)	-	0.366
At 'past week'					
Dull Pain	15 (7.0)	6 (2.8)	6 (2.8)	3 (1.4)	0.524
Aching Pain	171 (80.3)	55 (25.8)	59 (27.7)	57 (26.8)	0.701
Numbness Pain	15 (7.0)	5 (2.3)	2 (0.9)	8 (3.8)	0.144
Stabbing Pain	41 (19.2)	16 (7.5)	11 (5.2)	14 (6.6)	0.563
Tingling Pain	12 (5.6)	3 (1.4)	2 (0.9)	7 (3.3)	0.157
Cramping Pain	11 (5.2)	6 (2.8)	3 (1.4)	2 (0.9)	0.288
Burning Pain	1 (0.5)	-	1 (0.5)	-	0.366
Cutting Pain	1 (0.5)	1 (0.5)	-	-	0.366
'at present'					
Dull Pain	13 (6.1)	6 (2.8)	3 (1.4)	1 (0.5)	0.564
Aching Pain	104 (48.8)	36 (16.9)	34 (16.0)	34 (16.0)	0.928
Numbness Pain	8 (3.8)	3 (1.4)	1 (0.5)	1 (0.5)	0.403
Stabbing Pain	23 (10.8)	8 (3.8)	7 (3.3)	8 (3.8)	0.952
Tingling Pain	2 (0.9)	-	-	2 (0.9)	0.133
Cramping Pain	6 (2.8)	2 (0.9)	3 (1.4)	1 (0.5)	0.598
Burning Pain	1 (0.5)	-	-	1 (0.5)	0.366

1Chi-square test

6.5 Result of physical endurance during pregnancy at recruitment: DRI

Physical endurance was measured by using the DRI (Salén et al., 1994). The DRI consists of a 12-item questionnaire that evaluates physical functions including: 'dressing; outdoor walks; climbing stairs; sitting for a longer time; standing bent over a sink; carrying a bag; making a bed; running; light work; heavy work; lifting heavy objects; and participating in exercise/sports'(Longo et al, 2010, p.126). The 12 items are divided into three categories: basic daily life activities (Questions 1–4); physical activities (Questions 5-8); work-related/vigorous activities (Questions 9–12). Each item is scored with a 100 mm VAS. The score is determined by measuring the distance (mm) on the 10-cm line between "without difficulty" (0 points) and "not at all" (100 points) (Salén et al., 1994; Longo et al., 2010). Statistical analysis was performed using one-way ANOVA to compare the mean ($\bar{\mathbf{x}}$) and standard deviation for the three groups. Table 13 shows details of the DRI for the 12 items.

During pregnancy, the results showed that running, lifting heavy objects and undertaking heavy work were marked as most difficult in the DVD-based group and Usual Care group. The internet-group found the most difficulty with running, participating in exercise/sports and lifting heavy objects. The mean values for the DRIs for each category were as follows: for the basic daily life activities (dressing (mean=23.3), outdoor walks (mean=19.0), climbing stairs (mean=22.8), sitting for a longer time (mean=32.8)); physical activities (standing bent over a sink (mean=19.7), carrying a bag (mean=15.7), making a bed (mean=23.1), running (mean=39.6)) and work-related/vigorous activities (light work (mean=16.3), heavy work (mean=45.9), lifting heavy objects (mean=47.7), participating in exercise/sports (mean=37.1)) (see Figure 20). There were no significant differences noted in the results of the DRI score during pregnancy at recruitment.

Table 13: DRI in mm (mm) at pregnancy for three groups at recruitment (mean values) (n=213)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	P-value *
Dressing	23.3 (26.7)	0-100	22.0 (25.5)	0-80	24.5 (27.5)	0-87	23.2 (27.4)	0-100	0.860
Outdoor walking	19.0 (22.7)	0-100	19.3 (20.9)	0-90	19.9 (25.0)	0-80	17.7 (22.5)	0-100	0.830
Climbing stairs	22.8 (25.8)	0-100	22.0 (24.5)	0-90	24.4 (27.1)	0-90	22.1 (26.0)	0-100	0.828
Sitting for a long time	32.8 (23.7)	0-100	34.1 (24.4)	0-100	33.1 (23.4)	0-90	31.2 (23.5)	0-80	0.761
Standing bent over a sink	19.7 (22.3)	0-100	18.5 (18.6)	0-70	24.0 (25.1)	0-90	16.8 (22.5)	0-100	0.136
Carrying a bag	15.7 (20.2)	0-85	18.0 (20.7)	0-80	15.7 (21.8)	0-85	13.4 (18.1)	0-60	0.391
Making a bed	23.1 (25.0)	0-100	25.2 (24.5)	0-100	24.2 (27.9)	0-100	19.9 (22.4)	0-80	0.404
Running	39.6 (34.5)	0-100	40.5 (33.8)	0-100	41.1 (36.5)	0-100	37.1 (33.4)	0-100	0.759
Doing light work	16.3 (19.7)	0-100	14.8 (19.6)	0-70	17.8 (19.1)	0-80	16.2 (20.6)	0-100	0.679
Doing heavy work	45.9 (31.1)	0-100	48.4 (30.7)	0-100	48.1 (30.3)	0-100	41.1 (32.1)	0-100	0.284
Lifting heavy objects	47.7 (32.1)	0-100	48.1 (32.6)	0-100	50.8 (30.7)	0-100	44.3 (32.9)	0-100	0.483
Participating in exercise /sport	37.1 (30.7)	0-100	36.4 (29.7)	0-100	39.0 (31.2)	0-100	35.9 (31.7)	0-100	0.811
DRI total	28.6 (19.7)	0-87	29 (18.9)	0-71	30.2 (20.5)	0-87	26.6 (19.7)	0-80	0.475

*One-way ANOVA

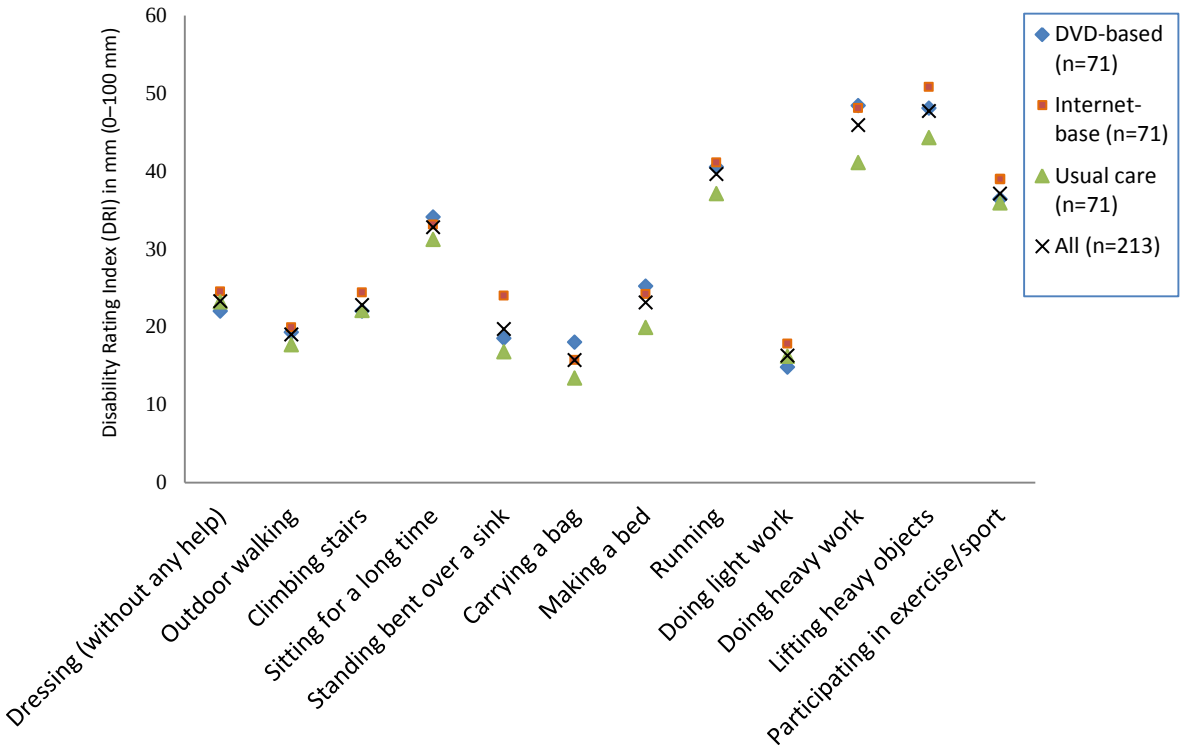


Figure 20: DRI at recruitment for three groups (0–100 mm- mean values)

6.6 Analysis of outcome before intervention (at discharge from the hospital) and after intervention (at six weeks and four months postpartum) (Objective 2)

The primary outcome measure was reported on LPP. The secondary outcome measures were tested for physical endurance and changes in core muscles. Physical endurance was reported on the DRI, and changes in core muscles measured in physical testing and diastasis recti. Acceptability of exercise was measured by using a self-recording sheet. Postpartum follow-up data were collected from 128 participants (six weeks postpartum) and 105 participants (four months). The repeated measures ANOVA statistics were compared against the VAS scale, DRI scale and diastasis recti data of the three groups. The results were described from discharge (before intervention) to six weeks and four months postpartum (after intervention). The results of the biographical and demographic analysis during the six-week and four months follow-up did not reveal significant differences between three groups (see Table 14, 15, 16, 17).

Table 14: Biographical profile of women per group at six weeks postpartum (n=128)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	P-value*
Age (years)	31.3 (4.5)	18-40.4	31.2 (4.6)	18-40.4	30.5 (5.0)	19.6-40	32.1 (3.7)	22.2-40	0.263
Height (cm)	160.6 (5.1)	150-175	160.7 (4.6)	150-168	161.1 (5.5)	150-175	159.9(5.3)	150-169.5	0.554
weight (Kg)	67.2 (9.1)	52-95.4	67.2 (7.6)	57-86	67.5 (10.3)	52-91.5	67 (9.5)	53.5-95.4	0.961
Gestation week	36.5 (1.6)	34-40.5	36.7 (1.5)	34.1-40.5	36.2 (1.5)	34-40	36.6 (1.7)	34-39.5	0.398
BMI at 6 weeks postpartum	23.2 (3.2)	15.2-32.7	23.0 (2.8)	17.9-29.4	23.4 (3.5)	18.2-30.8	23.1 (3.5)	15.2-32.7	0.862
BMI at recruitment	26.0 (3.3)	18.9-36.1	26.0(2.9)	20.4-33.5	25.9 (3.3)	20.6-33.6	26.2 (3.6)	18.9-36.1	0.942

*One-way ANOVA

Table 15: Demographical profile of women per group at six weeks postpartum (n=128)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)	p-value 1
Education					0.203
Secondary school	1 (0.8)	–	1 (0.8)	–	
High school	19 (14.8)	2 (1.6)	8 (6.3)	9 (7.0)	
College	17 (13.3)	5 (3.9)	5 (3.9)	7 (5.5)	
Bachelor's degree	79 (61.7)	32 (25)	22 (17.2)	25 (19.5)	
Master's degree	12 (9.4)	4 (3.1)	6 (4.7)	2 (1.6)	
Marital status					0.349
Single	3 (2.3)	1 (0.8)	2 (1.6)	–	
Married	125 (97.7)	42 (32.8)	40 (31.3)	43 (33.6)	
Employment Status					0.882
Fulltime	88 (68.8)	28(21.9)	28 (21.9)	32 (25.0)	
Part time	7 (5.5)	3 (2.3)	2 (1.6)	2 (1.6)	
Unemployed	33 (25.8)	12 (9.4)	12 (9.4)	9 (7.0)	
Exercise Before Pregnancy					0.929
Yes	67(52.3)	22 (17.2)	23 (18.0)	22 (17.2)	
No	61 (47.7)	21 (16.4)	19 (14.8)	21 (16.4)	
Exercise During Pregnancy					0.904
Yes	71 (55.5)	25 (19.5)	23 (18.0)	23 (18.0)	
No	57 (44.5)	18 (14.1)	19 (14.8)	20 (15.6)	
Type of exercise before pregnancy					0.702
To take a walk over 30 minutes per day	36 (28.1)	10 (7.8)	13 (10.1)	13 (12.0)	
Brisk walking	4 (3.1)	1 (0.8)	1 (0.8)	2 (1.6)	
Yoga	6 (4.7)	2 (1.6)	3 (2.3)	1 (0.8)	
Aerobic exercise	7 (5.5)	3 (2.3)	1 (0.8)	3 (2.3)	
Swim	4 (3.1)	3 (2.3)	1 (0.8)	–	
Gym	3 (2.3)	1 (0.8)	1 (0.8)	1 (0.8)	
Ball exercise	3 (2.3)	2 (1.6)	1 (0.8)	–	
running	4 (3.1)	1 (0.8)	1 (0.8)	2 (1.6)	

Table 15: continued

Type of exercise during pregnancy					0.520
To take a walk over 30 minutes per day	61 (47.6)	19 (14.8)	19 (14.8)	23 (17.9)	
Brisk walking	1 (0.8)	–	1 (0.8)	–	
Yoga	6 (4.7)	4 (3.1)	2 (1.6)	–	
Aerobic exercise	1 (0.8)	1 (0.8)	–	–	
Gym	2 (1.6)	1 (0.8)	1 (0.8)	–	

1Chi-square test

Table 16: Biographical profile of women per group at four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	$\bar{x}$ (SD)	Range	P-value*
Age (years)	31.5 (4.4)	18-40.4	30.8 (4.7)	18-40.4	31.2 (4.7)	19.6-40	30.8 (4.7)	18-40.4	0.291
Height (cm)	160.5 (5.1)	150-175	160.2 (4.5)	150-168	160.5 (5.6)	152-175	160 (5.1)	150-169.5	0.414
weight (Kg)	53.4 (7.1)	42-80	52.9 (5.9)	42-70	53.4 (7.7)	42-70	53.8 (7.8)	42-80	0.879
Gestation week	36.4 (1.6)	34-40.5	36.7 (1.4)	34.1-40.5	36.0 (1.5)	34-40	36.5 (1.7)	34-39.5	0.184
BMI at recruitment	25.9 (3.2)	18.9-36.1	26.1 (2.8)	22.3-33.5	26.5 (3.3)	20.6-33.6	26.0 (3.5)	18.9-36.1	0.843
BMI at 4 months postpartum	22.4 (3.1)	14.8-33.1	22.3 (2.5)	18.2-29.3	22.7 (3.5)	17.8-30.1	22.2 (3.4)	14.8-33.1	0.847

*One-way ANOVA

Table 17: Demographical profile of women per group at four months postpartum (n=105)

	All	DVD-based	Internet-base	Usual care	
Characteristics	N (%)	N (%)	N (%)	N (%)	p-value 1
Education					0.105
High school	15 (14.3)	1 (1.0)	6 (5.7)	8 (7.6)	
College	16 (15.2)	4 (3.8)	5 (4.8)	7 (6.7)	
Bachelor's degree	62 (59.0)	26 (24.8)	15 (14.3)	21 (20.0)	
Master's degree	12 (11.4)	4 (3.8)	6 (5.7)	2 (1.9)	
Marital status					0.295
Single	3 (2.9)	1 (1.0)	2 (1.9)	–	
Married	102 (97.1)	34 (32.4)	30 (28.6)	38 (32.6)	
Employment Status					0.999
Fulltime	74 (70.5)	25(23.8)	22 (21.0)	27 (25.7)	
Part time	6 (5.7)	2 (1.9)	2 (1.9)	2 (1.9)	
Unemployed	25 (23.8)	8 (7.6)	8 (7.6)	9 (8.6)	
Exercise Before Pregnancy					0.785
Yes	56 (53.3)	17 (16.2)	18 (17.1)	21 (20.0)	
No	49 (46.7)	18 (17.1)	14 (13.3)	17 (16.2)	
Exercise During Pregnancy					0.845
Yes	60 (57.1)	21 (20.0)	17 (16.2)	22 (21.0)	
No	45 (42.9)	14 (13.3)	15 (14.3)	16 (15.2)	
Type of exercise before pregnancy					0.751
To take a walk over 30 minutes per day	28 (26.7)	9 (8.6)	9 (8.6)	10 (9.5)	
Brisk walking	4 (3.8)	1 (1.0)	1 (1.0)	2 (1.9)	
Yoga	5 (4.8)	2 (1.9)	2 (1.9)	1 (1.0)	
Aerobic exercise	6 (5.7)	3 (2.9)	1 (1.0)	2 (1.9)	
Swim	3 (2.9)	1 (1.0)	1 (1.0)	1 (1.0)	
Gym	4 (3.8)	1 (1.0)	2 (1.9)	1 (1.0)	
Ball exercise	2 (1.9)	1 (1.0)	1 (1.0)	–	
running	4 (3.8)	–	1 (1.0)	3 (2.9)	

Table 17: continued

Type of exercise during pregnancy					0.402
To take a walk over 30 minutes per day	50 (47.6)	15 (14.3)	15 (14.3)	20 (19.0)	
Brisk walking	1 (1.0)	–	1 (1.0)	–	
Yoga	6 (5.7)	3 (2.9)	1 (1.0)	2 (1.9)	
Gym	2 (1.9)	1 (1.0)	1 (1.0)	–	
Ball exercise	1 (1.0)	1 (1.0)	–	–	

1Chi-square test

6.6.1 Primary outcome: LPP

6.6.1.1 Pain intensity

LPP measured the pain intensity participants felt at that specific time (present) and in the 'past week'. The results revealed that the mean value of LLP (before intervention) 'at present' after childbirth was 30.8mm in the DVD-based group, 43.9mm in the Internet-based group and 41.2mm in the Usual Care group respectively. Pain in relation to the 'past week' was reported as 53.7mm in the DVD-based group, 46.0mm in the Internet-based group and 48.1mm in the Usual Care group. The pain intensity scale 'at present' and related to 'past week' illustrated that the scale for the Internet-based group was higher than the Usual Care and DVD-based groups. Nevertheless, the pain intensity scale at 'past week' confirmed that the scale for the DVD-based group was higher than the Internet-based group and Usual Care group.

After six weeks of intervention, the mean value of the pain scale 'at present' was 4.5mm in the DVD-based group, 11.1mm in the Internet-based group and 13.8mm in the Usual Care group. Pain in the 'past week' was reported as 13.7mm in the DVD-based group, 9.2mm in the Internet-based group and 21.8mm in the Usual Care group. The pain recorded in relation to present pain for the Usual Care group was higher than the Internet-based group and DVD-based group (see Tables 18 and 19). The results obtained from measurement of LLP intensity at 'past week' reported that the Internet-based group exhibited less pain than the DVD-based group and Usual Care group.

After four months of intervention, the mean value of pain recorded 'at present' was 2.8mm in the DVD based group, 3.2mm in the Internet based group and 5.6mm in the Usual Care

group. Regarding pain related to 'past week', the DVD-based group reported 7.1mm, the Internet-based group 4.1mm and the Usual Care group 9.7mm (p>0.05) (see Tables 18 and 19).

Table 18: VAS in mm (0-100) of LPP 'at present' in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
At discharge	38.5	28.4	30.8	25.7	43.9	29.0	41.2	29.4
At six weeks postpartum	9.9	15.5	4.5	11.2	11.1	16.1	13.8	17.4
At four months postpartum	4	10.4	2.8	9.2	3.2	7.1	5.6	13.4

Table 19: VAS in mm (0-100) of LPP at 'past week' in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
At discharge	49.3	25.5	53.7	24.7	46.0	23.5	48.1	27.8
At six weeks postpartum	15.2	18.7	13.7	19.6	9.2	13.5	21.8	19.9
At four months postpartum	7.1	13.5	7.1	11.7	4.1	9.8	9.7	17.0

The results of LPP 'at present' and ''past week'' were measured prior to the intervention (at discharge), after six weeks and after four months. A repeated measures ANOVA with a Greenhouse-Geisser correction displayed that the mean VAS scale 'at present' differed sig-

nificantly between time points [F(1.488, 151.808)=117.693, p<0.001]. The between groups interaction time of measurement was not statistically significant (see Table 20). The comparison of the LPP scores ('at present' pain) between each point of measurement in the three groups, showed no significant difference between the three groups at six weeks postpartum. (see Table 21; Figure 21).

It should be mentioned that the results in the mean VAS scale at 'past week' differed significantly between time points [F(1.706, 174.039)=148.774, p<0.001]. The interaction time of measurement between groups was not statistically significant (see Table 20). The comparison of the LPP scores (at 'past week' pain) between each point of measurement in the three groups, exhibited a significant difference between the three groups at six weeks postpartum (p< 0.005). Moreover, it confirmed the Internet-based group had more of a reduction in pain intensity (-16.62mm) than the DVD-based group (-8.12mm) and the Usual Care group (reference) (see Table 21; Figure 22).

An evaluation of pain intensity 'at present' after intervention for each group from discharge period to four months postpartum, explained that the pain level for the DVD-based group decreased from 30.8mm to 2.8mm, from 43.9mm to 3.2mm for the Internet-based group, and from 41.2mm to 5.6mm for the Usual Care group. Pain levels in 'past week' reduced considerably for all groups: in the DVD-based group (by 53.7mm to 7.1mm), Internet-based group (by 46.0mm to 4.1mm) and Usual Care group (by 48.1mm to 9.7mm). Pain levels with respect to 'past week' illustrated that the Internet-based group had less pain intensity than the DVD-based group and the Usual Care group (see Tables 18, 19). In addition, 42.2% of the participants reported no pain, 49.2% mild pain and 8.6% moderate pain at six weeks postpartum. Moreover, 65.7% of women felt no pain and 29.5% of participants had mild pain at four months postpartum (see Table 22).

Table 20: Differences, at each point of measurement, in LPP 'at present' and 'past week' among the three study groups (n=105)

Variables	SS	df	MS	Fr	p-value
LPP 'at present'					
Within subject					
Time	72164.693	1.488	48487.515	117.693	<0.001*
Time x group	1481.750	2.977	497.794	1.208	0.309
Error	62542.288	151.808	411.982		
Between subject					
Group	1191.783	2	595.892	3.434	0.036
Error	17700.464	102	173.534		
LPP at 'past week'					
Within subject					
Time	105587.111	1.706	61882.101	148.774	<0.001*
Time x group	1988.181	3.413	582.613	1.401	0.241
Error	72390.753	174.039	415.946		
Between subject					
Group	839.233	2	419.617	2.765	0.068
Error	15478.868	102	151.754		

Note: r = Two-way repeated measure ANOVA

* p <0.0168

Table 21: Comparison of the LPP scores between each point of measurement in the three groups (n=105)

Variables	B	SE	t	p-value	95% CI
LPP ('at present')					
Discharge period					
DVD-based vs Usual care	-10.38	6.595	-1.574	0.119	-23.46 to 2.70
Internet-based vs Usual care	2.66	6.754	0.395	0.693	-10.72 to 16.06
Six weeks postpartum					
DVD-based vs Usual care	-9.24	3.565	-2.593	0.011	-16.31 to -2.17
Internet-based vs Usual care	-2.66	3.651	-0.728	0.468	-9.90 to 4.582
Four months postpartum					
DVD-based vs Usual care	-2.80	2.455	-1.141	0.257	-7.67 to 2.06
Internet-based vs Usual care	-2.37	2.515	-0.945	0.347	-7.36 to 2.61
LPP ('past week')					
Discharge period					
DVD-based vs Usual care	5.55	5.996	0.927	0.356	-6.37 to 17.45
Internet-based vs Usual care	-2.12	6.141	-0.346	0.730	-14.30 to 10.05
Six weeks postpartum					
DVD-based vs Usual care	-8.12	4.252	-1.912	0.059	-16.51 to 0.30
Internet-based vs Usual care	-12.62	4.354	-2.899	0.005*	-21.26 to -3.98
Four months postpartum					
DVD-based vs Usual care	-2.59	3.148	-0.824	0.412	-8.83 to 3.65
Internet-based vs Usual care	-5.54	3.224	-1.721	0.088	-11.94 to 0.84

* $p < 0.0168$

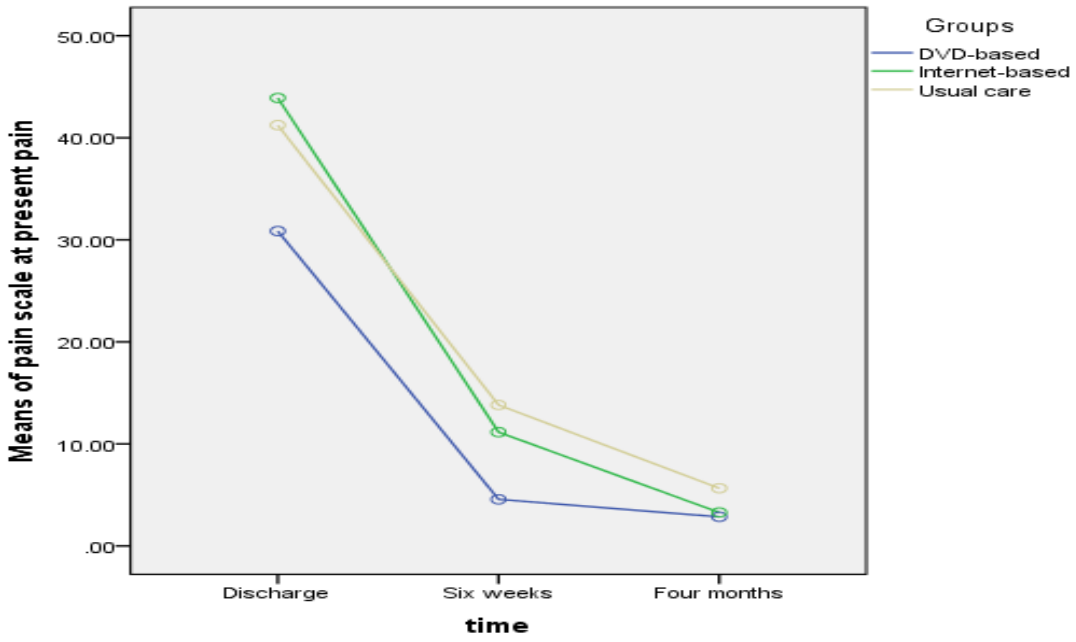


Figure 21: LLP ('at present') between each point of measurement in the three groups (0–100 mm- mean values)

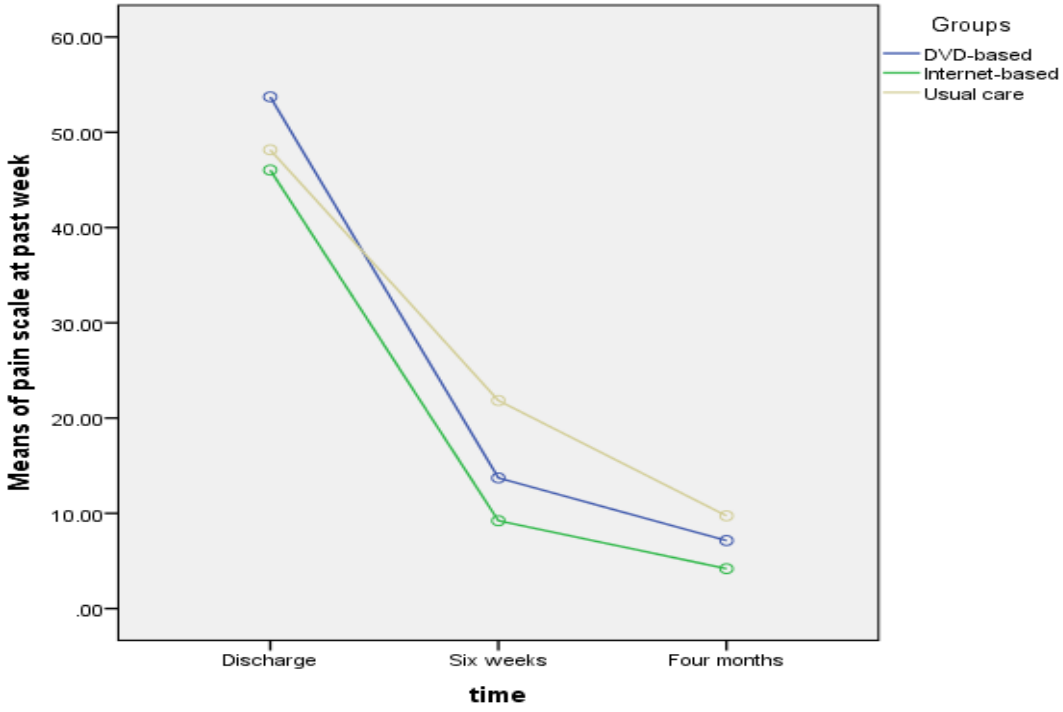


Figure 22: LLP ('past week') between each point of measurement in the three groups (0–100 mm- mean values)

Table 22: LPP levels at six weeks (n=128) and four months (n=105) postpartum

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)
Six weeks postpartum				
'At present'				
No pain	72 (56.3)	31 (24.2)	20 (15.6)	21 (16.4)
Mild pain	49 (38.3)	11 (8.6)	20 (15.6)	18 (14.1)
Moderate pain	7 (5.5)	1 (0.8)	2 (1.6)	4 (3.1)
At 'past week'				
No pain	54 (42.2)	24 (18.8)	16 (12.5)	14 (10.9)
Mild pain	63 (49.2)	18 (14.1)	22 (17.2)	23 (18.0)
Moderate pain	11 (8.6)	1 (0.8)	4 (3.1)	6 (4.7)
Four months postpartum				
'At present'				
No pain	84 (80.0)	30 (28.6)	25 (23.8)	29 (27.6)
Mild pain	19 (18.1)	4 (3.8)	7 (6.7)	8 (7.6)
Moderate pain	2 (1.9)	1 (1.0)	-	1 (1.0)
At 'past week'				
No pain	69 (65.7)	22 (21.0)	24 (22.9)	23 (21.9)
Mild pain	31 (29.5)	12 (11.4)	7 (6.7)	12 (11.4)
Moderate pain	5 (4.8)	1 (1.0)	1 (1.0)	3 (2.9)

6.6.1.2 Pain areas, pain sensations

After six weeks' intervention, 74 participants had pain 'at present' (57.81 %) and 56 have had pain in the 'past week' (43.75%). For LPP distribution at six weeks postpartum, most women described the pain in the lower back area 'at present' (n=45, 35.1%) and 'past week' (n=61, 47.6%). At four months postpartum, pain experience in the present and 'past week' were reported as 34.3% (n=37) and 20% (n=21). The pain area 'at present' was in the lower back (n=16, 15.2%), and in the 'past week' was reported as 29.5% in the lower back (see Table 23, 24).

With respect to the type of pain sensation at six weeks postpartum, most of the women reported aching pain 'at present' (n=50, 39.4%) and in the 'past week' (n=63, 49.2%). At four months postpartum, the most frequent pain sensation was also indicated as aching pain. The percentage of aching pain was reported as 19.2% 'at present' and 34.2% in the 'past week' (see Tables 25, 26).

Table 23: Report on the area of LPP distribution at six weeks postpartum (n=128)

	All	DVD-based	Internet-base	Usual care
Characteristics	N (%)	N (%)	N (%)	N (%)
'at present'				
Lower back	45 (35.1)	10 (7.8)	19 (14.8)	16 (12.5)
Anterior pelvic	1 (0.8)	-	-	1 (0.7)
Posterior pelvic	5 (3.9)	1 (0.8)	1 (0.8)	3 (2.3)
Lower back and Anterior pelvic	2 (1.6)	1 (0.8)	1 (0.8)	-
Lower back and Posterior pelvic	2 (1.6)	-	-	2 (1.6)
At 'past week'				
Lower back	61 (47.6)	17 (13.2)	21 (16.4)	23 (17.9)
Anterior pelvic	3 (2.3)	-	1 (0.8)	2 (1.6)
Posterior pelvic	7 (5.4)	1 (0.8)	3 (2.3)	3 (2.3)
Lower back and Anterior pelvic	2 (1.6)	1 (0.8)	1 (0.8)	-
Lower back and Posterior pelvic	1 (0.8)	-	-	1 (0.8)

Table 24: Report on the area of LPP distribution at four months postpartum (n=105)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)
'at present'				
Lower back	16 (15.2)	3 (2.8)	6 (5.7)	7 (6.6)
Anterior pelvic	-	-	-	-
Posterior pelvic	5 (4.7)	2 (1.9)	1 (1.0)	2 (1.9)
At 'past week'				
Lower back	31 (29.5)	11 (10.4)	7 (6.7)	13 (12.4)
Anterior pelvic	-	-	-	-
Posterior pelvic	4 (3.8)	2 (1.9)	1 (1.0)	1 (1.0)
Lower back and Posterior pelvic	2 (1.9)	-	1 (1.0)	1 (1.0)

Table 25: Pain sensation at six weeks postpartum per group (n=128)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)
'at present'				
Dull Pain	5 (3.9)	1 (0.8)	-	4 (3.1)
Aching Pain	50 (39.4)	11 (8.7)	19 (15.0)	20 (15.7)
Numbness Pain	3 (2.3)	-	2 (1.6)	1 (0.8)
Stabbing Pain	8 (6.3)	1 (0.8)	2 (1.6)	5 (3.9)
Tingling Pain	2 (1.6)	1 (0.8)	1 (0.8)	-
At 'past week'				
Dull Pain	9 (7.0)	3 (2.3)	1 (0.8)	5 (3.9)
Aching Pain	63 (49.2)	18 (14.1)	22 (17.2)	23 (18.0)
Numbness Pain	3 (2.3)	-	1 (0.8)	2 (1.6)
Stabbing Pain	10 (7.8)	1 (0.8)	3 (2.3)	6 (4.7)
Tingling Pain	2 (1.6)	1 (0.8)	1 (0.8)	-
Cutting Pain	1 (0.8)	-	-	1 (0.8)

Table 26: Pain sensation at four months postpartum per group (n=105)

Characteristics	All N (%)	DVD-based N (%)	Internet-base N (%)	Usual care N (%)
'at present'				
Dull Pain	2 (1.9)	-	-	2 (1.9)
Aching Pain	20 (19.2)	5 (4.8)	7 (6.7)	8 (7.7)
At 'past week'				
Dull Pain	5 (4.8)	1 (1.0)	-	4 (3.8)
Aching Pain	34 (32.4)	13 (12.4)	8 (7.6)	13 (12.4)

6.6.2 Secondary outcome: physical endurance and changes in core muscles

6.6.2.1 Physical endurance: DRI

The following sections (6.6.2.1) will describe the results from three categories: 1) basic daily life activities: dressing, outdoor walks, climbing stairs, sitting for a longer time; 2) physical activities: standing bent over a sink, carrying a bag, making a bed, running; 3) work-related/vigorous activities: light work, heavy work, lifting heavy objects, in addition to participating in exercise/sports. There mean values of each item were reported, and moreover, a repeated measures ANOVA analysis to compare differences between groups and times (pre-intervention: discharge; after intervention: six weeks and four months).

The mean values pertaining to the DRI scales presented each item at discharge period, six weeks and four months in Tables 27, 28 and 29. Prior to intervention, the mean values of the DRI scales of all participants reported: 1) basic daily life activities: dressing (mean=27.1; SD= 26.7), outdoor walks (mean=24.3; SD=27.3), climbing stairs (mean=31.1; SD=27.2), sitting for a longer time (mean=37.8; SD=26.3); 2) physical activities: standing bent over a sink

(mean=25.0; SD=24.6), carrying a bag (mean=26.7; SD=26.6), making a bed (mean=36.2; SD=30.6), running (mean=63.0; SD=32.4); 3) work-related/vigorous activities: light work (mean=21.9; SD=24.9), heavy work (mean=57.4; SD=33.0), lifting heavy objects (mean=58.3; SD=32.6) and participating in exercise/sports (mean=51.0; SD=33.7) (see Table 27).

After six weeks' intervention, the mean values of the DRI scales of all participants revealed: 1) basic daily life activities: dressing (mean=1.4; SD= 5.3), outdoor walks (mean=1.4; SD=5.2), climbing stairs (mean=2.8; SD=7.9), sitting for a longer time (mean=9.3; SD=13.9); 2) physical activities: standing bent over a sink (mean=4.9; SD=11.7), carrying a bag (mean=4.1; SD=9.5), making a bed (mean=6.0; SD=12.2), running (mean=9.5; SD=17.3); 3) work-related/vigorous activities: light work (mean=3.2; SD=7.5), heavy work (mean=13.7; SD=19.4), lifting heavy objects (mean=13.9; SD=19.8) and participating in exercise/sports (mean=9.2; SD=15.2) (see Table 28).

At four months postpartum, results demonstrated reduced levels regarding DRI and the mean values related to DRI were easily below 10mm. For the three categories: 1) basic daily life activities: dressing (mean=1.00; SD= 5.2), outdoor walks (mean=0.8; SD=4.5), climbing stairs (mean=1.5; SD=7.4), sitting for a longer time (mean=4.9; SD=11.9); 2) physical activities: standing bent over a sink (mean=2.2; SD=8.8), carrying a bag (mean=3.4; SD=11.2), making a bed (mean=2.5; SD=7.4), running (mean=4.0; SD=10.8); 3) work-related/vigorous activities: light work (mean=1.0; SD=4.0), heavy work (mean=6.0; SD=13.2), lifting heavy objects (mean=6.5; SD=14.3) and participating in exercise/sports (mean=3.2; SD=9.2) (see Table 29).

Table 27: DRI in mm (0-100) of the basic daily life activities in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Dressing								
At discharge	27.1	26.7	29.1	30.2	26.8	26.2	25.5	24.2
At six weeks postpartum	1.4	5.3	0.5	3.3	1.4	5.5	2.3	6.4
At four months postpartum	1.0	5.2	0.8	5.0	0.7	3.6	1.3	6.6
Outdoor walks								
At discharge	24.3	27.3	27.5	30.8	19.0	25.3	25.8	25.3
At six weeks postpartum	1.4	5.2	0.5	3.3	1.8	6.0	1.9	5.8
At four months postpartum	0.8	4.5	0.2	1.6	1.0	3.9	1.0	6.4
Climbing stairs								
At discharge	31.1	27.2	32.4	28.5	24.3	24.5	35.7	27.6
At six weeks postpartum	2.8	7.9	1.4	5.5	2.9	9.4	4.0	8.3
At four months postpartum	1.5	7.4	0.8	2.8	2.0	7.8	1.8	9.8
Sitting for a longer time								
At discharge	37.8	26.3	42.7	28.9	36.4	25.6	34.5	24.7
At six weeks postpartum	9.3	13.9	7.9	11.5	7.3	11.0	12.4	17.5
At four months postpartum	4.9	11.9	4.5	10.1	2.6	7.1	7.2	15.8

Table 28: DRI in mm (0-100) of the physical activities in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Standing bent over a sink								
At discharge	25.0	24.6	27.8	28.8	26.4	24.6	21.3	20.1
At six weeks postpartum	4.9	11.7	1.4	4.2	4.3	9.2	8.6	16.5
At four months postpartum	2.2	8.8	2.0	6.3	0.1	0.8	4.3	13.2
Carrying a bag								
At discharge	26.7	26.6	28.2	28.6	24.6	26.4	27.1	25.4
At six weeks postpartum	4.1	9.5	3.7	9.7	4.2	8.8	4.4	10.1
At four months postpartum	3.4	11.2	3.7	11.1	1.4	4.2	5.0	14.8
Making a bed								
At discharge	36.2	30.6	35.1	33.1	34.2	29.6	38.9	29.5
At six weeks postpartum	6.0	12.2	4.8	9.8	5.0	8.9	8.0	16.1
At four months postpartum	2.5	7.4	2.2	5.4	0.7	2.5	4.2	10.7
Running								
At discharge	63.0	32.4	60.2	33.9	58.2	33.0	69.4	30.2
At six weeks postpartum	9.5	17.3	5.7	10.9	9.1	16.8	13.2	21.8
At four months postpartum	4.0	10.8	2.8	7.1	3.9	12.3	5.1	12.4

Table 29: DRI in mm (0-100) of the work-related/vigorous activities in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Light work								
At discharge	21.9	24.9	23.4	25.7	20.4	24.2	21.8	25.3
At six weeks postpartum	3.2	7.5	1.4	4.2	5.9	10.3	2.7	6.6
At four months postpartum	1.0	4.0	0.5	2.3	1.4	5.5	1.0	3.8
Heavy work								
At discharge	57.4	33.0	56.8	34.1	51.4	32.5	63.1	32.4
At six weeks postpartum	13.7	19.4	10.7	17.0	14.5	16.5	15.9	23.5
At four months postpartum	6.0	13.2	6.0	13.1	3.9	9.2	7.8	16.1
Lifting heavy objects								
At discharge	58.3	32.6	57.7	34.7	54.2	32.2	62.3	31.2
At six weeks postpartum	13.9	19.8	10.7	18.3	13.9	17.0	16.9	23.0
At four months postpartum	6.5	14.3	7.4	15.9	2.9	8.1	8.6	16.4
Participating in exercise/sports								
At discharge	51.0	33.7	45.1	35.0	52.2	32.8	55.4	33.4
At six weeks postpartum	9.2	15.2	4.1	9.4	11.4	18.0	12.2	16.3
At four months postpartum	3.2	9.2	2.5	7.8	2.6	8.0	4.4	11.3

Repeated measure ANOVA displayed a significant time effect for all 12 items on the DRI scales which were evaluated (dressing: [$F(1.064, 108.527)=93.138$, $p<0.001$]; outdoor walks: [$F(1.083, 110.419)=75.673$, $p<0.001$]; climbing stairs: [$F(1.187, 121.097)=111.527$, $p<0.001$]; sitting for a longer time: [$F(1.301, 132.747)=117.819$, $p<0.001$]; standing bent over a sink: [

F(1.328, 135.495)=66.948, p<0.001]; carrying a bag: [F(1.260, 128.526)=67.811, p<0.001]; making a bed: [F(1.185, 120.885)=102.434, p<0.001]; running: [F(1.462, 149.108)=262.866, p<0.001]; light work: [F(1.119, 114.117)=64.979, p<0.001]; heavy work: [F(1.531, 156.130)=173.364, p<0.001]; lifting heavy objects: [F(1.568, 159.959)=181.538, p<0.001]; and participating in exercise/sports: [F(1.247, 127.214)=160.445, p<0.001]; see Tables 30,31,32). Although there was a tendency towards greater reduction in the DRI scales in both intervention groups relative to the Usual Care group during the 4 months of the study, the group-by-time interaction was not significant. Furthermore, post hoc analysis illustrated no significant differences between the three groups.

In addition, comparison of the DRI scores (12 items) between each point of measurement in the three groups (see Tables 33,34,35), established that the standing bent over a sink item revealed a significant difference between the DVD-based group and Usual Care group at six weeks postpartum (p< 0.008). It confirmed that the DVD-based group had a scale that was more reduced (-7.25mm) than the Usual Care group (see Table 34).

Table 30: Differences, at each point of measurement, in DRI of the basic daily life activities among the three study groups (n=105)

Variables	SS	df	MS	Fr	p
Dressing					
Within subject					
Time	46959.151	1.064	44135.059	93.138	0.000*
Time x group	285.252	2.128	134.049	0.283	0.768
Error	51427.541	108.527	473.870		
Between subject					
Group	5.425	2	2.712	0.029	0.971
Error	9482.660	102	92.967		
Outdoor walks					
Within subject					
Time	36952.604	1.083	34135.152	75.673	0.000*
Time x group	1074.758	2.165	496.406	1.100	0.340
Error	49808.550	110.419	451.087		
Between subject					
Group	109.427	2	54.713	0.533	0.588
Error	10463.680	102	102.585		
Climbing stairs					
Within subject					
Time	57348.591	1.187	48304.621	111.527	0.000*
Time x group	1595.616	2.374	671.992	1.552	0.212
Error	52449.470	121.097	433.119		
Between subject					
Group	301.263	2	150.631	1.338	0.267
Error	11483.093	102	112.579		
Sitting for a longer time					
Within subject					
Time	67371.699	1.301	51766.863	117.819	0.000*
Time x group	1729.201	2.603	664.339	1.512	0.219
Error	58326.265	132.747	439.378		
Between subject					
Group	170.351	2	85.175	0.560	0.573
Error	15519.084	102	152.148		

Note: r = Two-way repeated measure ANOVA
* p <0.0168

Table 31: Differences, at each point of measurement, in DRI of the physical activities among the three study groups (n=105)

Variables	SS	df	MS	Fr	p-value
Standing bent over a sink					
Within subject					
Time	33182.700	1.328	24986.467	66.948	<0.001*
Time x group	2063.635	2.656	776.955	2.082	0.113
Error	50556.245	135.459	373.222		
Between subject					
Group	28.815	2	14.408	0.134	0.875
Error	10946.133	102	107.315		
Carrying a bag					
Within subject					
Time	36707.691	1.260	29131.706	67.811	<0.001*
Time x group	204.710	2.520	81.230	0.189	0.874
Error	55215.169	128.526	429.603		
Between subject					
Group	85.195	2	42.598	0.319	0.727
Error	13601.055	102	133.344		
Making a bed					
Within subject					
Time	71578.125	1.185	60396.179	102.434	<0.001*
Time x group	56.385	2.370	23.788	0.040	0.976
Error	71274.885	120.885	589.611		
Between subject					
Group	278.593	2	139.297	0.913	0.404
Error	15554.317	102	152.493		
Running					
Within subject					
Time	219977.291	1.462	150479.847	262.866	<0.001*
Time x group	1101.675	2.924	376.811	0.658	0.575
Error	85357.811	149.108	572.458		
Between subject					
Group	868.763	2	434.381	2.073	0.131
Error	21373.485	102	209.544		

Note: r = Two-way repeated measure ANOVA
* p <0.0168

Table 32: Differences, at each point of measurement, in DRI of the work-related/vigorous activities among the three study groups (n=105)

Variables	SS	df	MS	Fr	p
Light work					
Within subject					
Time	27380.042	1.119	24472.775	64.979	<0.001*
Time x group	476.748	2.238	213.063	0.566	0.589
Error	42979.760	114.117	376.628		
Between subject					
Group	12.783	2	6.392	0.068	0.934
Error	9597.111	102	94.089		
Heavy work					
Within subject					
Time	159092.805	1.531	103935.829	173.364	<0.001*
Time x group	1276.216	3.061	416.878	0.695	0.559
Error	93603.308	156.130	599.523		
Between subject					
Group	646.852	2	323.426	1.323	0.271
Error	24936.640	102	244.477		
Lifting heavy objects					
Within subject					
Time	163348.890	1.568	104161.358	181.538	<0.001*
Time x group	685.509	3.136	218.561	0.381	0.776
Error	91780.047	159.959	573.771		
Between subject					
Group	604.246	2	302.123	1.176	0.313
Error	26215.331	102	257.013		
Participating in exercise/sports					
Within subject					
Time	141006.017	1.247	113058.541	160.445	<0.001*
Time x group	871.355	2.494	349.326	0.496	0.652
Error	89642.017	127.214	704.656		
Between subject					
Group	871.044	2	435.522	2.267	0.109
Error	19595.756	102	192.115		

Note: r = Two-way repeated measure ANOVA
* p <0.0168

Table 33: Comparison of the basic daily life activities between each point of measurement in the three groups (n=105)

Variables	B	SE	t	p-value	95% CI
Dressing					
Discharge period					
DVD-based vs Usual care	3.56	6.313	0.564	0.574	-8.95 to 16.08
Internet-based vs Usual care	1.23	6.466	0.191	0.849	-11.59 to 14.05
Six weeks postpartum					
DVD-based vs Usual care	-1.79	1.246	-1.442	0.152	-4.26 to 0.67
Internet-based vs Usual care	-0.96	1.276	-0.754	0.453	-3.49 to 1.57
Four months postpartum					
DVD-based vs Usual care	-0.45	1.252	-0.366	0.715	-2.94 to 2.02
Internet-based vs Usual care	-0.53	1.282	-0.417	0.678	-3.07 to 2.00
Outdoor walks					
Discharge period					
DVD-based vs Usual care	1.70	6.406	0.266	0.791	-11.00 to 14.40
Internet-based vs Usual care	-6.80	6.560	-1.037	0.302	-19.81 to 6.20
Six weeks postpartum					
DVD-based vs Usual care	-1.402	1.228	-1.142	0.256	-3.83 to 1.03
Internet-based vs Usual care	-0.09	1.258	-0.078	0.938	-2.59 to 2.39
Four months postpartum					
DVD-based vs Usual care	-0.76	1.074	-0.714	0.477	-2.89 to1.36
Internet-based vs Usual care	0.04	1.099	0.037	0.970	-2.14 to 2.22
Climbing stairs					
Discharge period					
DVD-based vs Usual care	-3.36	6.343	-0.530	0.597	-15.94 to 9.22
Internet-based vs Usual care	-11.41	6.496	-1.757	0.082	-24.29 to 1.46
Six weeks postpartum					
DVD-based vs Usual care	-2.65	1.856	-1.428	0.156	-6.33 to1.03
Internet-based vs Usual care	-1.17	1.901	-0.617	0.593	-4.94 to 2.59
Four months postpartum					
DVD-based vs Usual care	-0.98	1.757	-0.561	0.576	-4.47 to 2.50
Internet-based vs Usual care	0.18	1.800	0.105	0.916	-3.38 to 3.75

Table 33: continued

Sitting for a longer time					
Discharge period					
DVD-based vs Usual care	8.18	6.172	1.327	0.188	-4.05 to 20.43
Internet-based vs Usual care	1.91	6.321	0.302	0.763	-10.62 to 14.44
Six weeks postpartum					
DVD-based vs Usual care	-4.47	3.255	-1.376	0.172	-10.93 to 1.97
Internet-based vs Usual care	-5.07	3.333	-1.523	0.131	-11.68 to 1.53
Four months postpartum					
DVD-based vs Usual care	-2.66	2.784	-0.957	0.341	-8.18 to 2.85
Internet-based vs Usual care	-4.58	2.851	-1.607	0.111	-10.23 to 1.07

* p <0.0168

Table 34: Comparison of the physical activities between each point of measurement in the three groups (n=105)

Variables	B	SE	t	p-value	95% CI
Standing bent over a sink					
Discharge period					
DVD-based vs Usual care	6.54	5.781	1.131	0.261	-4.92 to 18.00
Internet-based vs Usual care	5.09	5.921	0.860	0.392	-6.65 to 16.83
Six weeks postpartum					
DVD-based vs Usual care	-7.25	2.684	-2.703	0.008*	-12.58 to-1.93
Internet-based vs Usual care	-4.37	2.749	-1.590	0.115	-9.82 to 1.08
Four months postpartum					
DVD-based vs Usual care	-2.34	2.061	-1.136	0.258	-6.43 to 1.74
Internet-based vs Usual care	-4.18	2.111	-1.983	0.050	-8.37 to 0.00
Carrying a bag					
Discharge period					
DVD-based vs Usual care	1.18	6.296	0.187	0.852	-11.30 to 13.66
Internet-based vs Usual care	-2.41	6.448	-0.275	0.708	-15.20 to 10.37
Six weeks postpartum					
DVD-based vs Usual care	-0.70	2.251	-0.314	0.754	-5.17 to 3.75
Internet-based vs Usual care	-0.20	2.305	-0.088	0.930	-4.77 to 4.37
Four months postpartum					
DVD-based vs Usual care	-1.28	2.638	-0.487	0.627	-6.51 to 3.94
Internet-based vs Usual care	-3.59	2.701	-1.330	0.186	-8.95 to 1.76
Making a bed					
Discharge period					
DVD-based vs Usual care	-3.80	7.224	-0.527	0.600	-18.13 to 10.52
Internet-based vs Usual care	-4.72	7.398	-0.639	0.524	-19.40 to 9.94
Six weeks postpartum					
DVD-based vs Usual care	-3.16	2.883	-1.099	0.274	-8.88 to 2.55
Internet-based vs Usual care	-3.02	2.953	-1.025	0.308	-8.88 to 2.83
Four months postpartum					
DVD-based vs Usual care	-1.92	1.720	-1.119	0.266	-5.33 to 1.48
Internet-based vs Usual care	-3.42	1.762	-1.947	0.054	-6.92 to 0.06

Table 34: continued

Running					
Discharge period					
DVD-based vs Usual care	-9.18	7.583	-1.212	0.228	-24.22 to 5.85
Internet-based vs Usual care	-11.19	7.766	-1.441	0.153	-26.59 to 4.21
Six weeks postpartum					
DVD-based vs Usual care	-7.57	4.047	-1.872	0.064	-15.60 to 0.45
Internet-based vs Usual care	-4.10	4.145	-0.990	0.325	-12.32 to 4.11
Four months postpartum					
DVD-based vs Usual care	-2.27	2.560	-0.889	0.376	-7.35 to 2.80
Internet-based vs Usual care	-1.22	2.621	-0.467	0.641	-6.42 to 3.97

* $p < 0.0168$

Table 35: Comparison of the work-related/vigorous activities between each point of measurement in the three groups (n=105)

Variables	B	SE	t	p-value	95% CI
Light work					
Discharge period					
DVD-based vs Usual care	1.58	5.890	0.269	0.788	-10.09 to 13.27
Internet-based vs Usual care	-1.37	6.032	-0.228	0.820	-13.33 to 10.59
Six weeks postpartum					
DVD-based vs Usual care	-1.33	1.734	-0.770	0.443	-4.77 to 2.10
Internet-based vs Usual care	3.17	1.775	1.788	0.077	-0.34 to 6.69
Four months postpartum					
DVD-based vs Usual care	-0.48	0.959	-0.502	0.617	-2.38 to 1.42
Internet-based vs Usual care	0.354	0.982	0.360	0.719	-1.59 to 2.30
Heavy work					
Discharge period					
DVD-based vs Usual care	-6.30	7.744	-0.814	0.418	-21.66 to 9.05
Internet-based vs Usual care	-11.75	7.930	-1.482	0.141	-27.48 to 3.97
Six weeks postpartum					
DVD-based vs Usual care	-5.20	4.573	-1.139	0.258	-14.27 to 3.86
Internet-based vs Usual care	-1.39	4.684	-0.297	0.767	-10.68 to 7.90
Four months postpartum					
DVD-based vs Usual care	-1.89	3.122	-0.067	0.545	-0.08 to 4.29
Internet-based vs Usual care	-3.98	3.197	-1.248	0.215	-10.32 to 2.35
Lifting heavy objects					
Discharge period					
DVD-based vs Usual care	-4.65	7.678	-0.606	0.546	-19.88 to 10.57
Internet-based vs Usual care	-8.15	7.863	-1.036	0.302	-23.74 to 7.44
Six weeks postpartum					
DVD-based vs Usual care	-6.25	4.646	-1.347	0.181	-15.47 to 2.95
Internet-based vs Usual care	-3.06	4.758	-0.645	0.521	-12.50 to 6.37
Four months postpartum					
DVD-based vs Usual care	-1.25	3.341	-0.376	0.708	-7.88 to 5.37
Internet-based vs Usual care	-5.71	3.422	-1.670	0.098	-12.50 to 1.07

Table 35: continued

Participating in exercise/sports					
Discharge period					
DVD-based vs Usual care	-10.30	7.925	-1.300	0.196	-26.02 to 5.41
Internet-based vs Usual care	-3.22	8.116	-0.398	0.692	-19.32 to 12.86
Six weeks postpartum					
DVD-based vs Usual care	-8.09	3.512	-2.305	0.023	-15.06 to -1.12
Internet-based vs Usual care	-0.83	3.597	-0.231	0.818	-7.96 to 6.30
Four months postpartum					
DVD-based vs Usual care	-1.90	2.177	-0.874	0.384	-6.22 to 2.41
Internet-based vs Usual care	-1.81	2.229	-0.815	0.417	-6.24 to 2.60

* $p < 0.0168$

6.6.2.2 Changes in core muscles: physical testing and diastasis recti.

Prior to the intervention, the mean values of body weight from the discharge period were shown as 63.5kg in the DVD-based group, 65.5kg in the Internet-based group and 63.7kg in the Usual Care group. After six weeks of intervention, the mean values regarding body weight indicated 59.2kg in the DVD-based group, 61.3kg in the Internet-based group and 59.1kg in the Usual Care group. At four months postpartum, the mean values regarding body weight indicated 57.2kg in the DVD-based group, 57kg in the Internet-based group and 57.1kg in the Usual Care group (see Table 36). Additionally, repeated measure ANOVA revealed a significant time effect for body weight evaluated ($F(1.227, 125.163)=60.378$, $p<0.001$), whilst the result of the group-by-time interaction was not significant ($F(2.454, 125.163)=28.401$, $p=0.772$) (see Table 37). The comparison of body weight between each point of measurement in the three groups, revealed no significant difference between three groups at six weeks postpartum and four months postpartum (see Table 38). Similarly, post hoc analysis indicated no significant differences between the three groups.

It should be noted that the results of waist circumference prior to the intervention and the mean values of waist circumference from the discharge period were shown as 91.3cm in the DVD-based group, 93.2cm in the Internet-based group and 92.1cm in the Usual Care group. After six weeks of intervention, the mean values regarding waist circumference indicated 82.3cm in the DVD-based group, 83.9cm in the Internet-based group and 83.4cm in the Usual Care group. At four months postpartum, the mean values regarding waist circumference indicated 77.3cm in the DVD-based group, 78.8cm in the Internet-based group and 79cm in the Usual Care group (see Table 36). In this case, repeated measure ANOVA indicated a significant time effect for waist circumference evaluated ($F(1.566, 159.757)=212.849$, $p<0.001$),

while the result of the group-by-time interaction was not significant (F(3.132, 159.757)=0.182, p=0.915) (see Table 37). The comparison of the waist circumference between each point of measurement in the three groups, revealed no significant difference between three groups at six weeks postpartum and four months postpartum (see Table 38). Likewise, post hoc analysis showed no significant differences between the three groups.

The diastasis recti measurements were undertaken in three different places; 4.5cm umbilicus above, umbilicus and 4.5cm umbilicus below. Prior to the intervention, the mean values of the umbilicus 4.5cm above depicted the same results of 1.8 fingers in all three groups. The mean values of the umbilicus revealed 2.6 fingers in the DVD-based group, 2.7 fingers in the Internet-based group and 2.7 fingers in the Usual Care group. The 4.5cm umbilicus below results reported 1.3 fingers in the DVD-based group, 1.5 fingers in the Internet-based group and 1.6 fingers in the Usual Care group. At six weeks postpartum, the mean values of the umbilicus 4.5cm above depicted 0.7 fingers in the DVD-based group, 0.8 fingers in the Internet-based group and 0.8 fingers in the Usual Care group. The mean values of the umbilicus revealed 1.4 fingers in the DVD-based group, 1.4 fingers in the Internet-based group and 1.6 fingers in the Usual Care group. The 4.5cm umbilicus below results indicated 0.5 fingers in the DVD-based group, 0.6 fingers in the Internet-based group and 0.6 fingers in the Usual Care group. At four months postpartum, the mean values of the umbilicus 4.5cm above, depicted 0.4 fingers in the DVD-based group, 0.3 fingers in the Internet-based group and 0.5 fingers in the Usual Care group. The mean values of the umbilicus revealed 0.9 fingers in the DVD-based group, 0.7 fingers in the Internet-based group and 1.0 finger in the Usual Care group. The 4.5cm umbilicus below results reported 0.4 fingers in all three groups (see Table 36).

When all three groups were compared after six weeks and four months intervention, the mean values of the umbilicus point reported a decrease of 2.6 fingers to 0.9 fingers in the DVD-based group, a reduction of 2.7 to 0.7 fingers in the Internet-based group and a decrease of 2.7 to 1.0 fingers in the Usual Care group. Here, repeated measure ANOVA illustrated a significant time effect for the diastasis recti evaluated (4.5cm umbilicus above: [$F(1.786, 188.829)=289.230$, $p<0.001$)], umbilicus: [$F(1.629, 166.188)=244.240$, $p<0.001$)] and 4.5cm umbilicus below: [$F(1.491, 152.115)=129.930$, $p<0.001$)]). The result of the group-by-time interaction was not significant in the three places (see Table 37). The comparison of the diastasis recti (4.5cm umbilicus above, umbilicus and 4.5cm umbilicus below) between each point of measurement in the three groups, revealed no significant difference between three groups at six weeks and four months postpartum (see Table 38).

Table 36: The mean values of physical testing and diastasis recti in discharge (n=158), six weeks postpartum (n=128) and four months postpartum (n=105)

	All		DVD-based		Internet-base		Usual care	
Characteristics	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Physical testing								
Body weight								
At discharge	64.2	9.8	63.5	7.4	65.5	12.2	63.7	9.6
At six weeks postpartum	59.8	9.0	59.2	6.1	61.3	11.1	59.1	9.3
At four months postpartum	57.1	10.3	57.2	6.1	57.0	14.7	57.1	9.2
Waist circumference								
At discharge	92.2	9.5	91.3	8.4	93.2	9.9	92.1	10.3
At six weeks postpartum	83.2	7.5	82.3	6.5	83.9	8.7	83.4	7.4
At four months postpartum	78.4	7.1	77.3	7.0	78.8	6.8	79.0	7.4
Diastasis recti								
Umbilicus 4.5 cm above								
At discharge	1.8	0.5	1.8	0.5	1.8	0.7	1.8	0.6
At six weeks postpartum	0.8	0.5	0.7	0.5	0.8	0.5	0.8	0.5
At four months postpartum	0.4	0.4	0.4	0.4	0.3	0.3	0.5	0.5
Umbilicus								
At discharge	2.6	0.8	2.6	0.8	2.7	0.7	2.7	0.8
At six weeks postpartum	1.5	0.6	1.4	0.6	1.4	0.6	1.6	0.5
At four months postpartum	0.9	0.6	0.9	0.5	0.7	0.5	1.0	0.7
Umbilicus 4.5 cm below								
At discharge	1.5	0.7	1.3	0.8	1.5	0.8	1.6	0.6
At six weeks postpartum	0.6	0.5	0.5	0.5	0.6	0.5	0.6	0.5
At four months postpartum	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.3

Table 37: Differences, at each point of measurement, in physical testing and diastasis recti among the three study groups (n=105)

Variables	SS	df	MS	Fr	p-value
Physical testing					
Body weight					
Within subject					
Time	2724.428	1.227	2220.235	60.378	<0.001*
Time x group	69.700	2.454	28.401	0.772	0.488
Error	4602.495	125.163	36.772		
Between subject					
Group	39.025	2	19.513	0.240	0.787
Error	8299.625	102	81.369		
Waist circumference					
Within subject					
Time	10370.739	1.566	6621.389	212.849	<0.001*
Time x group	17.753	3.132	5.667	0.182	0.915
Error	4969.790	159.757	31.108		
Between subject					
Group	50.973	2	25.487	0.502	0.607
Error	5182.306	102	50.807		
Diastasis recti					
Umbilicus 4.5 cm above					
Within subject					
Time	108.041	1.786	60.459	289.230	<0.001*
Time x group	0.355	3.572	0.100	0.476	0.732
Error	38.102	188.829	0.202		
Between subject					
Group	0.170	2	0.085	0.469	0.627
Error	18.459	102	0.181		
Umbilicus					
Within subject					
Time	154.858	1.629	95.046	244.240	<0.001*
Time x group	1.742	3.259	0.535	1.374	0.251
Error	64.672	166.188	0.389		
Between subject					
Group	1.307	2	0.653	2.446	0.092
Error	27.239	102	0.267		

Table 37: continued

Umbilicus 4.5 cm below					
Within subject					
Time	67.697	1.491	45.394	129.930	<0.001*
Time x group	1.446	2.983	0.485	1.387	0.249
Error	53.154	152.115	0.349		
Between subject					
Group	0.567	2	0.284	1.479	0.235
Error	19.667	102	0.193		

Note: r = Two-way repeated measure ANOVA
* p <0.0168

Table 38: Comparison of the physical testing and diastasis recti between each point of measurement in the three groups (n=105)

Variables	B	SE	t	p-value	95% CI
Physical testing-Body weight					
Discharge period					
DVD-based vs Usual care	-0.22	2.314	-0.096	0.923	-4.81 to 4.36
Internet-based vs Usual care	1.08	2.370	0.762	0.448	-2.89 to 6.50
Six weeks postpartum					
DVD-based vs Usual care	0.06	2.122	0.031	0.975	-4.14 to 4.27
Internet-based vs Usual care	2.19	2.173	1.009	0.315	-2.11 to 6.50
Four months postpartum					
DVD-based vs Usual care	0.13	2.453	0.054	0.957	-4.73 to 4.99
Internet-based vs Usual care	-0.03	2.512	-0.015	0.988	-5.01 to 4.94
Physical testing- Waist circumference					
Discharge period					
DVD-based vs Usual care	-0.81	2.257	-0.360	0.720	-5.29 to 3.66
Internet-based vs Usual care	1.09	2.312	0.475	0.636	-3.48 to 5.68
Six weeks postpartum					
DVD-based vs Usual care	-1.09	1.775	-0.615	0.540	-4.61 to 2.42
Internet-based vs Usual care	0.47	1.818	0.260	0.796	-3.13 to 4.07
Four months postpartum					
DVD-based vs Usual care	-1.77	1.672	-1.064	0.290	-5.09 to 1.53
Internet-based vs Usual care	-0.25	1.712	-0.147	0.884	-3.64 to 3.14
Diastasis recti					
Umbilicus 4.5 cm above					
Discharge period					
DVD-based vs Usual care	-0.08	0.152	-0.537	0.592	-0.38 to 0.21
Internet-based vs Usual care	-0.07	0.155	-0.042	0.966	-0.31 to 0.30
Six weeks postpartum					
DVD-based vs Usual care	-0.09	0.125	-0.776	0.439	-0.34 to 0.15
Internet-based vs Usual care	0.007	0.128	0.051	0.959	-0.24 to 0.26
Four months postpartum					
DVD-based vs Usual care	-0.11	0.108	-1.017	0.312	-0.32 to 0.10
Internet-based vs Usual care	-0.16	0.111	-1.466	0.146	-0.38 to 0.05

Table 38: continued

Umbilicus					
Discharge period					
DVD-based vs Usual care	-0.43	0.195	-2.213	0.029	-0.08 to -0.04
Internet-based vs Usual care	-0.11	0.200	-0.588	0.588	-0.51 to 0.27
Six weeks postpartum					
DVD-based vs Usual care	-0.20	0.143	-1.431	0.155	-0.49 to 0.07
Internet-based vs Usual care	-0.12	0.147	-0.823	0.412	-0.41 to 0.17
Four months postpartum					
DVD-based vs Usual care	-0.15	0.142	-1.078	0.284	-0.43 to 0.12
Internet-based vs Usual care	-0.27	0.145	-1.871	0.064	-0.55 to 0.01
Umbilicus 4.5 cm below					
Discharge period					
DVD-based vs Usual care	-0.39	0.182	-2.187	0.031	-0.75 to -0.03
Internet-based vs Usual care	-0.16	0.186	-0.893	0.374	-0.53 to 0.20
Six weeks postpartum					
DVD-based vs Usual care	-0.11	0.127	-0.881	0.380	-0.36 to 0.14
Internet-based vs Usual care	-0.02	0.130	-0.197	0.854	-0.28 to 0.23
Four months postpartum					
DVD-based vs Usual care	-0.01	0.106	-0.177	0.860	-0.23 to 0.19
Internet-based vs Usual care	-0.02	0.109	-0.234	0.815	-0.24 to 0.19

* $p < 0.0168$

6.6.3 Acceptability of exercise: uptake, adherence and completion rate of three modes of instruction

The rate of completion of postpartum exercises as measured by data at 6 weeks postpartum was 77.3%: at four months postpartum it was 55.2%. The completion rate of each group at six weeks postpartum was 25.8% in the DVD-based group (n=33), 28.9% in the Internet-based group (n=37) and 22.7% in the Usual Care group (n=29). At four months, the rates were 24.8% in the DVD-based group (n=26), 18.1% in the Internet-based group (n=19) and 12.4% in the Usual Care group (n=13). Table 39 and Figure 16 show the rate of completion for each group.

In this case, 29 participants did not adhere to the use of the exercise programmes. The reasons were child duty (51.7%), felt tired (27.5%), not interesting (13.7%) and family opposed (6.89%) at six weeks postpartum. The most reasons for not doing exercise at four months postpartum were feeling tired (48.9%), child duty (38.2%) and not interested in continuing the exercise (12.7%).

Table 39: Postpartum exercise of completion rate at six weeks (n=128) and four months postpartum (n=105) for three group

	All	DVD-based	Internet-base	Usual care
Characteristics	N (%)	N (%)	N (%)	N (%)
Six weeks postpartum				
Yes	99 (77.3)	33 (25.8)	37 (28.9)	29 (22.7)
No	29 (22.7)	10 (7.8)	5 (3.9)	14 (10.9)
Four months postpartum				
Yes	58 (55.2)	26 (24.8)	19 (18.1)	13 (12.4)
No	47 (44.8)	9 (8.6)	13 (12.4)	25 (23.8)

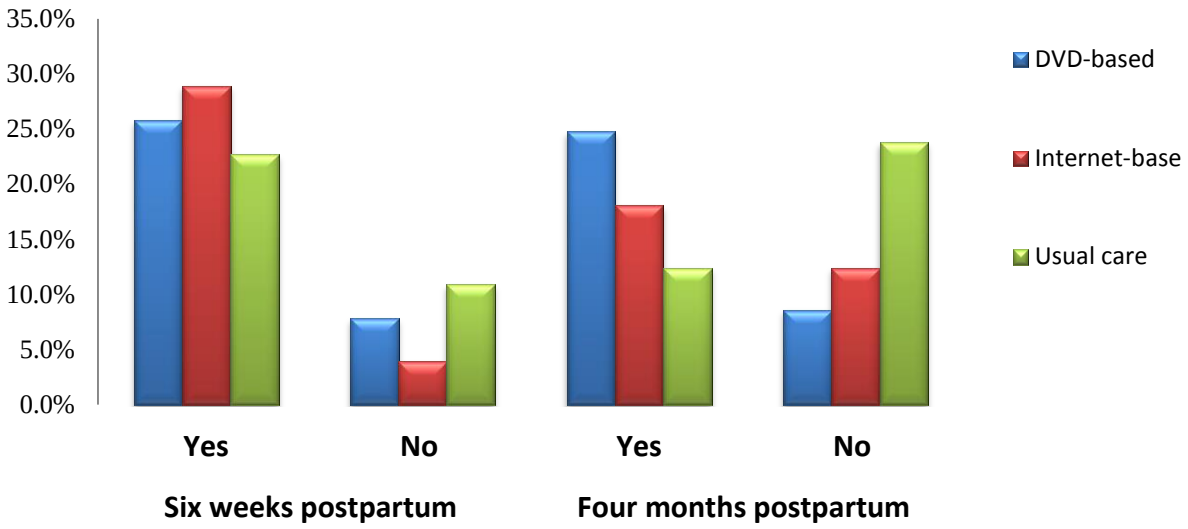


Figure 23: Completion rate of postpartum exercise per group

The characteristics of adherence to and frequency of completion of the prescribed exercises from the three groups during the 16-week period (four months postpartum) are shown in Table 40. The mean of exercise frequency ascertained that the Internet-based group (mean=6.86; SD=5.79) was performing exercises more than the DVD-based group (mean=5.47; SD=2.39) and the Usual Care group group (mean=5.06; SD=3.39) after one to six weeks postpartum. At four months' intervention, the Internet-based group (mean=5.62; SD=2.44) were exercising more than the other two groups (DVD-base: mean=4.86; SD=2.04, Usual care: mean=4.78; SD=2.73). The Internet-based group had higher exercise adherence than DVD-based group and Usual Care group at weeks 1, 3 to 10 and 14 (see Table 40).

Table 40: Weekly exercise adherence at six weeks (n=99) and four months postpartum (n=58) for three groups (mean values)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	P -value1
Week 1	6.89 (4.35)	5.8-7.8	5.69 (2.56)	4.5-6.8	7.66 (4.84)	5.8-9.4	7.08 (4.98)	4.9-9.2	0.258
Week 2	7.38 (4.52)	6.4-8.3	6.40 (3.14)	5.2-7.5	7.61 (4.57)	6.0-9.2	8.24 (5.69)	5.8-10.5	0.305
Week 3	8.15 (4.98)	7.0-9.2	6.77 (2.32)	5.8-7.6	9.79 (7.06)	7.1-12.4	7.66 (3.27)	6.1-9.1	0.065
Week 4	7.64 (4.95)	6.5-8.7	6.76 (2.32)	5.8-7.6	9.35 (7.35)	6.5-12.2	6.61 (2.87)	5.3-7.9	0.073
Week 5	7.30 (5.02)	6.1-8.4	6.40 (2.41)	5.4-7.3	9.20 (7.15)	6.4-11.9	5.84 (3.07)	4.3-7.3	0.032
Week 6	7.58 (4.62)	6.4-8.7	7.07 (3.80)	5.5-8.6	8.53 (5.46)	6.3-10.7	6.80 (4.32)	4.4-9.1	0.402
Week 7	5.52 (2.91)	4.7-6.3	5.42 (2.71)	4.3-6.5	5.87 (3.51)	3.9-7.7	5.30 (2.68)	3.6-6.9	0.851
Week 8	7.63 (4.20)	6.4-8.8	6.52 (1.70)	5.7-7.2	9.76 (5.87)	6.7-12.7	6.75 (3.93)	4.2-9.2	0.035
Week 9	6.32 (3.06)	5.4-7.1	5.27 (1.75)	4.4-6.0	7.88 (4.21)	5.7-10.0	6.00 (2.14)	4.5-7.4	0.025
Week 10	5.70 (2.19)	5.1-6.3	5.33 (1.73)	4.6-6.0	6.05 (2.67)	4.7-7.3	5.90 (2.25)	4.3-7.4	0.541
Week 11	5.76 (1.65)	5.3-6.2	5.70 (1.54)	5.0-6.3	5.66 (1.78)	4.7-6.5	6.10 (1.79)	4.8-7.3	0.785
Week 12	5.55 (1.69)	5.0-6.0	5.41 (1.61)	4.7-6.0	5.44 (1.88)	4.5-6.3	6.10 (1.59)	4.9-7.2	0.540
Week 13	5.82 (1.69)	5.3-6.3	5.40 (1.50)	4.7-6.0	6.12 (1.70)	5.2-7.0	6.33 (2.06)	4.7-7.9	0.274
Week 14	5.78 (1.64)	5.3-6.2	5.40 (1.59)	4.7-6.1	6.18 (1.75)	5.2-7.1	6.00 (1.50)	4.8-7.1	0.328
Week 15	5.53 (2.03)	4.9-6.1	5.40 (1.59)	4.7-6.1	5.06 (2.56)	3.6-6.4	6.66 (1.65)	5.3-7.9	0.154
Week 16	5.04 (1.53)	4.5-5.4	4.86 (1.39)	4.2-5.4	5.12 (1.70)	4.2-6.0	5.33 (1.65)	4.0-6.6	0.724
Week 1 to week 6	5.87 (4.25)	5.0-6.7	5.47 (2.39)	4.6-3.2	6.86 (5.79)	4.9-8.7	5.06 (3.39)	3.7-6.3	0.191
Week 7 to week 16	5.09 (2.33)	4.4-5.7	4.86 (2.04)	4.0-5.6	5.62 (2.44)	4.4-6.8	4.78 (2.73)	3.1-6.4	0.491

1 One-Way ANOVA

* p <0.0168

The exercise programme included eight types: Abdominal breathing exercises, head and neck exercises, chest exercises, leg exercises, gluteus exercises, vaginal contraction exercises, abdominal muscle exercises and knee-to-chest exercises. The most commonly used exercise types at six weeks in the DVD-based group were the abdominal breathing exercises (mean=27.0; SD: 11.3), vaginal contraction exercises (mean=20.0; SD=12.3) and head and neck exercises (mean=18.2; SD=11.7). Abdominal breathing exercises (mean=25.2; SD: 13.0), breast exercises (mean=22.5; SD=13.2) and gluteus exercises (mean=21.6; SD=13.7) were most common in the Internet-based group. Abdominal breathing exercises (mean=22.6; SD: 14.2), breast exercises (mean=19.1; SD=12.9) and vaginal contraction exercises (mean=19.0; SD=12.7) were most common in the Usual Care group (see Table 41).

Four months postpartum, the most common exercise types were breast exercises (mean=45.4; SD=25.5), vaginal contraction exercises (mean=41.4; SD=20.7) and leg exercises (mean=39.6; SD=23.5) in the DVD based group. Abdominal breathing exercises (mean=51.4; SD: 22.6), breast exercises (mean=49.0; SD=25.4) and head and neck exercises (mean=48.9; SD=22.4) in the Internet-based group. Abdominal muscle exercises (mean=50.8; SD=25.4), head and neck exercises (mean=46.8; SD=29.4) and knee-to-chest exercises (mean=44.0; SD=28.5) were most common in the Usual Care group. There were no significant differences in results in the groups at six weeks and four months postpartum (see Table 41).

Table 41: Uptake exercise eight types at six weeks (n=99) and four months postpartum (n=58) for three groups (mean values)

	All		DVD-based		Internet-base		Usual care		
Characteristics	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	$\bar{x}$ (SD)	95% CI	P -value1
Six weeks postpartum									
Abdominal breathing exercises	25.0 (12.7)	25-28	27.0 (11.3)	20-33	25.2 (13.0)	19-31	22.6 (14.2)	14-30	0.646
Head and neck exercises	18.1 (13.0)	15-21	18.2 (11.7)	13-23	20.3 (14.2)	14-25	14.8 (12.6)	9-20	0.341
Breast exercises	19.1 (12.9)	16-22	16.9 (12.2)	11-22	22.5 (13.2)	17-27	19.1 (12.9)	11-23	0.238
Leg exercises	17.8 (12.9)	14-20	17.0 (13.9)	11-22	20.0 (12.8)	15-24	15.8 (13.1)	9-22	0.523
Gluteus exercises	18.1 (13.6)	14-21	17.5 (13.4)	12-22	21.6 (13.7)	15-27	14.9 (12.5)	9-20	0.257
Vaginal contraction exercises	20.1 (12.5)	17-22	20.0 (12.3)	15-24	21.4 (12.9)	16-26	19.0 (12.7)	14-23	0.771
Abdominal muscle exercises	15.5 (11.3)	12-18	16.7 (12.3)	11-22	16.0 (10.7)	11-20	12.1 (11.1)	4-19	0.551
Knee-to-Chest exercises	17.6 (11.0)	14-20	15.8 (12.7)	9-22	21 (8.9)	16-25	15.5 (10.5)	8-22	0.319
Four months postpartum									
Abdominal breathing exercises	43.4 (25.8)	35-51	39.4 (1.54)	26-51	51.4 (22.6)	38-64	39.5 (29.9)	16-62	0.379
Head and neck exercises	43.1 (25.9)	33-52	35.8 (27.3)	19-52	48.9 (22.4)	34-63	46.8 (29.4)	19-74	0.428
Breast exercises	45.9 (26.0)	36-55	45.4 (25.5)	30-60	49.0 (25.4)	33-64	40.5 (32.3)	6-74	0.807
Leg exercises	40.8 (24.1)	33-47	39.6 (23.5)	28-50	42.5 (24.2)	30-55	40.4 (27.5)	20-60	0.935
Gluteus exercises	41.3 (23.7)	34-48	38.9 (23.4)	28-49	44.4 (22.6)	32-56	42.3 (28.2)	19-63	0.775
Vaginal contraction exercises	42.6 (22.6)	36-48	41.4 (20.7)	32-50	43.0 (24.0)	31-54	44.1 (25.8)	27-60	0.943
Abdominal muscle exercises	40.6 (23.6)	33-47	39.1 (22.9)	28-49	38.3 (24.3)	25-51	50.8 (25.4)	27-74	0.472
Knee-to-Chest exercises	40.9 (24.9)	32-49	37.2 (23.3)	23-50	42.7 (25.7)	27-57	44.0 (28.5)	20-67	0.789

1 One-Way ANOVA

* p <0.0168

Chapter 7

Discussion

This chapter presents 1) a discussion of the systematic review of RCTs on the effectiveness of exercise on LPP among postnatal women, 2) a discussion of the findings of the PRCT study in Objective 2 (to compare the effectiveness of three methods of instruction of exercise on postpartum LPP: DVD-based, Internet-based and Usual care (leaflet-based)) and Objective 3 (to compare the acceptability (uptake, adherence and completion rate) of three modes of delivery: DVD-based, Internet-based and Usual care (leaflet based)), as well as the theories related to the three methods of instruction of exercise on postpartum LPP. This chapter also explores the implications of the three methods of instruction of exercise on postpartum LPP and the relationships between the reporting of postpartum physical endurance and uptake/adherence and completion rate of the three modes of delivery.

7.1 Discussion of the systematic review of RCTs on the effectiveness of exercise on LPP among postnatal women (objective 1)

The systematic review was undertaken to synthesise the evidence from RCTs and the effectiveness of physical exercise on LPP among postnatal women. A comprehensive, systematic search of the literature did not find any other systematic review focusing on the effectiveness of exercise on LPP among women after child birth. A narrative synthesis approach was adopted in the review to synthesise the evidence as meta-analysis was not feasible for making estimates of strength of effect due to variations in intervention components, outcome

measures, follow-up times and study quality among the selected studies. Three of the four selected trials were of relatively good methodological quality with blinded assessments and standardised and validated data collection tools to ensure internal validity and the robustness of the findings.

This review indicated that only a small number of RCTs have evaluated the effectiveness of exercise on LPP among postnatal women either as a primary or secondary outcome. Further, existing trials appeared to suggest inconsistent findings and did not adequately allow estimates of effect in either direction. Among the four trials included in this review, involving 251 post-natal women, three were rated as of 'good' methodological quality, with a score of 6-8 on a 10-point assessment scale, indicating fairly good methodological rigour. Among these, one trial that involved physical therapy with specific stabilising exercises proved to be effective in terms of reducing LPP intensity both after the intervention and at 1 and 2-year follow ups (Stuge et al., 2004a, 2004b). The same trial also showed significant positive effects of the exercise programme on other related variables such as functional status, health related quality of life and physical endurance (Stuge et al., 2004a, 2004b). The remaining two trials that were rated as of 'good' quality did not show any beneficial impact with respect to LPP intensity (Mens et al., 2000; Gutke et al., 2010b). However, improvements in gluteal pain on the right side was found in the intervention group in one trial (Mens et al., 2000) and a significant difference in pain frequency between the two groups at 3-month follow-up in the other (Gutke et al., 2010b). Many participants in the treatment group in one trial complained of increasing pain during the exercises with the majority attributing the pain to the exercise aimed at strengthening the hip extensors (Mens et al., 2000).

The review also indicated that the methods of delivering the interventions differed across trials and included a videotape with instruction of exercises to be performed at home with-

out supervision (Mens et al., 2000); individualised exercise programme performed mainly at home with guidance by the physical therapist with adjustments performed once a week or fortnightly (Stuge et al., 2004a, 2004b); home training with individual guidance and adjustment of the exercise programme every two weeks by one of two treating physiotherapists (Gutke et al., 2010b); and treatment sessions at the hospital (Chaudry et al., 2013). Compliance was measured using a training diary in two trials (Stuge et al., 2004a, 2004b; Gutke et al., 2010b) and a designated form in another one (Mens et al., 2000). The inconsistent findings in this review may be attributed to methodological factors, variability in the intervention elements and the way the interventions were administered. Previous research has highlighted the importance of the activation of muscles for motor control and stability of the lumbopelvic region (Vleeming et al., 1996; Richardson et al., 1999).

A recent pre and post-experimental study using convenient sampling is helpful in understanding the effect of Proprioceptive Neuromuscular Facilitation techniques on muscle endurance and functional performance on post-partum lumbo-pelvic pain. Compared with lumbo-pelvic stabilisation exercises the study suggested lumbopelvic stabilisation exercises to be beneficial for improving trunk muscle endurance, pain and functional ability in women with postpartum LPP (Tanvi et al., 2013). Among the trials included in this review, only one included thoroughly instructed, regularly supervised, high quality exercises designed to involve all the relevant muscles of the pelvic girdle (Stuge et al., 2004a, 2004b). There were also marked differences across trials with respect to type of exercises, frequency and duration, and the way the exercises and instructions were administered. Compliance with the intervention is also likely to significantly influence the outcomes and is an important indicator of an intervention's feasibility for future implementation. Among the trials included in this review, only one trial reported good compliance (Stuge et al., 2004a, 2004b). The ability

to exercise without provoking pain, possibility of training at home under the guidance of a therapist, use of a training diary, the ability to gradually increase the resistance of individually adapted exercises and the integration of muscle control into functional tasks were all found to be important to encourage compliance (Stuge et al., 2004a, 2004b). Although a VAS was used as a measure of pain intensity in all the trials, a range of pain related outcome measures was reported across trials. As it was evident in our review and as has been indicated by other researchers, a standardised set of outcome measures to accurately capture LPP is yet to be developed (Mens et al., 2000).

A rigorous methodological approach based on a well-defined research question with a comprehensive search strategy, clear inclusion and exclusion criteria, standardised quality assessment techniques and structured data extraction was used in this review. However, the review has certain limitations. Although RCTs are deemed to be the most rigorous method to determine the presence of a cause-effect relationship between an intervention and outcome, and therefore the highest quality of evidence for a systematic review (Kendall, 2003; Olivo et al., 2007), the restriction of RCTs as one of the inclusion criteria might have resulted in the exclusion of non-randomised and other experimental studies that could have yielded useful findings. Although the authors of one trial (Chaudry et al., 2013) were contacted for additional information about methodological aspects, this information could not be obtained. In this systematic review it was also unable to explore any potential publication bias resulting from exclusion of unpublished RCTs or findings reported in grey literature.

7.2 Discussion of the PRCT to assess the effectiveness and acceptability of the exercise programme delivered using DVD, internet or leaflet (usual care), on LPP among postnatal women

Phase 2 of the PRCT study aimed to assess the effectiveness and acceptability of an exercise programme delivered using three different modes of instruction (DVD-based, Internet-based and leaflet-based (usual care)), on LPP among postnatal women. The following discussion focusses on: 1) findings on response rate of the PRCT study, 2) findings on the pregnancy-related LPP rates at recruitment , 3) findings on the effectiveness of each of the modes of instruction of the exercise programme, 4) findings on the secondary outcome of physical endurance (DRI and diastasis recti), 5) findings on acceptability of the three modes of instruction, finally 6) a critical synthesis and discussion of both the systematic review and the pragmatic RCT in relation to the evidence about the mode of exercise delivery.

7.2.1 Response rate of the PRCT study

A total of 213 women were included in the study. One hundred and fifty eight (158) women received the intervention and the response rate was 74.18%. The follow-up response rates at six weeks and four months were 60.09% and 49.29% respectively. The response rates achieved in the current study corresponded to the original sample size calculations (see Section 4.5). Similar response rates have been reported in other studies using exercise interventions for postpartum pelvic girdle pain. For example, response rates of 74% and 68% at three months and six months postpartum follow-up were reported in an RCT (Gutke et al., 2010b). Mota et al. (2015), investigated the prevalence of diastasis recti abdominis at gestational week 35 and follow-up to six months postpartum, with a response rate of 83.1% (Mota et al., 2015). Robinson et al. (2010a) examined 283 women in gestation week 30 and followed up

to 12 weeks postnatal. The response rate was 63.2% (Robinson et al., 2010a). A self-reported survey has evaluated LPP in weeks 19–21 of pregnancy and at 6 months postpartum with a response rate of 69% and 84.6% respectively (Olsson et al., 2012a). In the current PRCT, women were identified and contacted through antenatal and postnatal clinic by the research midwife. The requirement for women to be willing to return to hospital and continue the study could have made an impact on the response rate.

7.2.2 Pregnancy-related LPP at recruitment

In the second phase of the study (PRCT), all of the participants were recruited into the study whilst they were pregnant. LPP was assessed via the VAS and DRI questionnaires. More than half of the women (53.5%) who enrolled in the study reported the onset of LPP during the third trimester of their pregnancy, 34.3 % of women during the second trimester and 12.2% during the first trimester. Additional studies have shown similar results regarding the onset of LPP, with most women experiencing pain for the first time in the third trimester. For instance, Brown and Johnston (2013) investigated 580 women with back and pelvic pain during pregnancy. The results indicated that 50.8% of women experienced pain in the final semester, 26.2% in the second trimester and 14.6% of women in the first trimester (Brown and Johnston, 2013). Another study reported that 40.7% of women started suffering from pain during the third trimester of pregnancy (Ansari et al., 2010).

Women suffering from LPP during pregnancy in the current study also reported that 53.2% were in mild pain, 38.6% in moderate pain at past week, and 32.3% in mild pain and 24.7% in moderate pain at present. Chang et al. (2012), reported that 74.9% of Taiwanese women had pregnancy-related LPP. Most of the women reported pain as mild to moderate in severity and that the pain interfered with a number of daily activities. Al-Sayegh et al. (2012), re-

ported that 35% of women have episodes of pregnancy-related, moderate LPP (Al-Sayegh et al., 2012). A survey investigating 1530 Australian women who had low back pain during pregnancy found that 61.8 % of women had moderately severe back pain (Stapleton et al., 2002). Skaggs et al. (2007), explored 599 of women with pregnancy-related musculoskeletal pain and found that 21% of women had experienced severe pain. Ansari et al. (2010), investigated 103 Iranian women with low back pain during pregnancy and found that the severity of low back pain was described mostly as being moderate (44%) or severe pain (33.9%). To and Wong (2003), studied women with back pain during pregnancy and found that the pain intensity of daily activities was mild (53.6%) and moderate pain (33.2%). Compared to previous studies, this study findings support that pain ranged from mild to moderate with an average score of 47 (scale of 0 to 100 mm) in past week, with 38.6% of the participants reporting moderate pain at past week and 24.7% at present (VAS 45-74 mm).

Participants in the current study pointed out that most pain areas were in the lower back and posterior pelvic area during pregnancy. Lower back area pain at past week and present were 49.8% and 30.5% respectively among the participants in the current study. Al-Sayegh et al. (2012) investigated 280 pregnant women with LPP. Those women who experienced pain locations reported pain in the lumbar spine (36.2%) and combined pain in the lumbar spine and pelvic girdle (29%). Nilsson-Wikmar et al. (2005), stated that for 103 women at 38 gestation weeks, most pain was recorded in the lower back. To and Wong (2003), investigated indications of the back pain area during pregnancy and found that 56.4% of women had pain in the lower back. Ansari et al. (2010), reported that 71.2% of pregnant women felt pain most frequently in the low back area (71.2%). However, the most common pregnancy related to LPP was described in the lower back pain area (To and Wong, 2003; Wang et al., 2004;

Nilsson-Wikmar et al., 2005; Ansari et al., 2010; Al-Sayegh et al., 2012; Brown and Johnston, 2013).

All participants in the current PRCT described the pain sensation during pregnancy as being mostly the feeling of aching and stabbing pain. Nilsson-Wikmar et al. (2005), informed that pregnant women with lower back pain experienced the most frequent pain sensation as dull/aching and the second most frequent sensation was stabbing/cutting. Wang et al. (2004), reported on 645 pregnant women with low back pain, who described the pain sensation as shooting and aching pain (Wang et al., 2004). Pregnancy-related LPP in the pelvic girdle has been described as stabbing, pain in the lower back, as a dull ache and in the thoracic spine as a burning sensation (Wu et al., 2004).

In summary, among the participants in the current study, the onset of pain was in the third trimester, pain intensity was between mild and moderate pain, most of the pain area was in the lower back and pain sensations were described as aching and stabbing pain. These results were similar to previous studies on pregnancy-related LPP, and the first contribution of such evidence for pregnancy-related LPP in Taiwan.

7.2.3 Effectiveness of the exercise programme delivered via three instruction modes on postpartum LPP (Objective 2)

The Phase 2 PRCT study contributes to the understanding of the effectiveness of an exercise programme delivered via three different modes of instruction (DVD-based, Internet-based and leaflet (Usual care)). This is the first study that has investigated the impact of postpartum exercise delivered through different modes of instruction on LPP in Taiwan. Overall, the results of the PRCT study showed a significant difference in VAS scores regarding LPP 'at present' and 'the past week' pain intensity assessment, and a significant change in the LPP of

pain intensity scores over time ($p<0.001$). Findings of the analysis of intensity of pain 'at present' and 'the past week' indicate that there was no significant difference between the three modes of instruction groups. But the comparison between the Internet-based group and the Usual Care group found that the pain intensity in the Internet-based group was significantly lower than the Usual Care group ($p= 0.005$). Pain in the 'past week' showed that the reduction in the Internet-based group was considerably higher (-12.62mm) than in the DVD-based group (-8.12mm) and Usual Care group. Adjustments (multiplied by three) of the p-values due to multiple comparisons were performed using Dunnett's post-hoc tests. This revealed that the Internet-based group demonstrated LPP at 'past week' pain intensity scores that were significantly lower than the Usual Care group.

The key finding of the Phase 2 PRCT study revealed that the exercise programme instructed via the Internet can have an impact on the LPP at six weeks postpartum. The Internet-based group VAS scores had decreased 12.62 mm in the LPP of at 'past week'. Similarly, the overall pain intensity scores deceased in each group over time (from discharge period to four months postpartum). As it is the first known Taiwanese study to report the impact of postpartum exercise delivered through three different modes of instruction using a PRCT, it is not possible to directly compare the findings from other studies. Several researchers have, however, indicated that DVDs or video tapes as exercise instruction media may be improving patients' health (Schoo et al., 2005; Petty et al., 2006; Khalil et al., 2012; McAuley et al., 2013;Moran et al., 2015). With respect to multimedia interventions in the postpartum period, Hausenblas et al. (2008b), used a multimedia CD-ROM for exercise on postpartum women. It was indicated that the multimedia CD-ROM of the exercise programme had significantly increased the self -efficacy and knowledge of exercise among the postpartum women. Previous studies have also supported the use of the Internet as an effective medium for the

delivery of exercise interventions in health care. McKay et al. (2001), found Internet-based interventions to be effective in increasing activity levels among diabetes patients who use the service with sufficient regularity. Spittaels et al. (2007), indicated that using a website-delivered intervention to disseminate the exercise information increased physical activity in the general population. The PRCT study makes a unique contribution in that women who used the exercise video instruction via the Internet experienced reduced LPP at six weeks postpartum.

In addition, the PRCT study reveals that the LPP decreased in the three groups over time. This study (PRCT) used repeated measures ANOVA statistics to compare pain intensity between the groups and at various time points. As reported, other studies used different data statistics to compare their outcomes regarding time follow-up. For example, Bastiaenen (2008), randomly allocated 126 women with pregnancy-related lower back pain into a group for brief self-management techniques and a usual care group. Follow-up outcomes were daily activities, pain and severity of main complaints at three months, six months and one year postpartum. Multivariable analysis was used to examine the effects of outcomes over time after the baseline. No significant result was found relevant to time, although a substantial reduction in pain was reported at one year postpartum.

A follow-up study by Elden described a reduction in pelvic girdle pain after delivery in different treatment groups, among 386 pregnant women with pelvic girdle pain randomly assigned to three different treatment groups. This study used the Mann-Whitney U-test to compare data and compared each time assessment outcome between three groups (standard treatment group, acupuncture group and stabilising exercises group). The outcome assessment was pain intensity. Participants received six weeks' treatment and follow-up within

1 week after the end of treatment and follow-up 12 weeks after delivery. Results revealed that 99% of women had recovered pain 12 weeks after delivery and a significant result with positive pain provocation tests found that women in the stabilising exercise group had less pain than in controls at 12 weeks after delivery (Elden et al., 2008b). Kvorning et al. (2004), assessed the use of acupuncture as an intervention to improve pelvic and low-back pain in late pregnancy. 72 pregnant women attended the study, 37 of them were in the acupuncture group and 35 in the control group. The impact of the intervention on pain intensity and the change over time was assessed by calculating weighted kappa coefficients. Pain intensity with change over time exhibited a decrease of 60% in pain intensity in the acupuncture group. In the control group the decrease was only 14%. Pain intensity was associated with physical activity, but it was determined that this decreased over time, in significantly more women in the acupuncture group than in the control group. However, the time of recovery from LPP on postpartum was not always entirely understood. Additionally, a limitation of this study in contrast to previous studies, is that it was hard to compare statistics (repeated measures ANOVA) from previous LLP studies.

The current PRCT study is the first known Taiwanese study to report LPP and postpartum exercise from a PRCT although there have been previous studies looking at coping strategies of women in pregnancy. For example, Chang et al. (2012), used a cross-sectional study to collect data from 187 Taiwanese women to understand the pain coping strategies of women with pregnancy-related LPP. Their results showed that 74.9% of women reported pregnancy-related LPP. Most of the women chose rest to reduce pain. In another cross-sectional study, Chang et al. (2015), analysed data from 295 pregnant women with LPP looking at the pain management options and uptake. The study found that only 12% of Taiwanese women seek treatment for pain. In another Taiwanese study, Yan et al. (2014), used a 12-week stability

ball exercise programme to evaluate the exercise effect on low back pain and daily life interference during pregnancy. A significant result was reported, as women who had the stability-ball exercise had less pain than the control group. However, these studies did not consider pain in the postpartum period.

Clinical approaches for LPP management have specified the importance of activation of muscles for motor control and stability of the lumbopelvic region (Richardson et al., 1999), and physical exercise has been indicated as a beneficial method for relieving LPP after childbirth (Mens et al., 2000; Stuge et al., 2004a, 2004b). In the PRCT in this study, the intervention was adopted from the postpartum exercise programme (delivered via leaflet) and comprises strengthening core abdominal and global muscles via abdominal muscle exercises, breathing exercises, head and neck exercises and leg exercises. In the PRCT, the exercise programme included eight components. The study compared three groups that made use of the eight components but did not compare the relationship between exercise adherence and eight components of exercise with LLP. The limitation of the study should consider that further research is required to clarify how many exercises were adhered to and which components are effective in reducing LPP among postpartum women.

7.2.4. The effectiveness of an exercise programme via three instruction modes on secondary outcomes (DRI)

The DRI (Salén et al., 1994) was used in the Phase 2 PRCT study to assess the physical endurance for daily activities for women affected by their experience of LPP. The DRI is calculated as a mean score for 12 categories of activities associated with physical functions: ‘dressing; outdoor walks; climbing stairs; sitting for a longer time; standing bent over a sink; carrying a bag; making a bed; running; light work; heavy work; lifting heavy objects; participating in ex-

ercise/sports' (Longo et al, 2010, p.126). In the phase 2 PRCT study findings, of the 12 categories of DRI, ability to perform heavy lifting and heavy work were marked as most difficult for all the three groups from pregnancy to four months postpartum. Nilsson-Wikmar (2005), reported a similar result for women who had more difficulty undertaking heavy lifting during pregnancy and after three months postpartum. This was the same finding with Nilsson-Wikmar and colleagues (2003), who reported that the women during six to ten months postpartum received the highest rating for heavy lifting and heavy work (Nilsson-Wikmar et al., 2003).

In relation to the above, findings from this PRCT study in relation to the 12 DRI categories showed that there is a significant difference between the DVD-based and Usual Care group at six weeks postpartum in the standing bent over a sink item ($p< 0.008$). Further findings relating to the DRI score was a reduction of the scores in each group over time (from discharge period to four months postpartum).

The Phase 2 PRCT study found that the LPP and DRI displayed decreased scores in each group over time. Participants in the DVD-based group had less pain 'at present' and lower pain scores on the standing bent over a sink item at six weeks postpartum. Although the findings suggested that the Internet-based group demonstrated significantly decreased scores in LPP and the DVD-based group had significantly decreased scores in DRI, the Usual Care group also had decreased scores in LPP and DRI. However, the link between DRI scores with LPP intensity scores has been evidenced by previous studies. For instance, in a cross-sectional design, Robinson et al. (2010b), investigated 283 women with pelvic girdle pain and disability at 30 gestation weeks. They realised that pain location with the DRI score had a large variation and the women suffering pain in the combined symphysis and bilateral posterior back areas reported the highest DRI score for disability.

Robinson and colleagues (2010a), followed up those women (n=238) until 12 weeks postpartum. The authors of this study proposed that the pain provocation tests and pre-pregnancy low back pain were significantly associated with DRI at 12 weeks postpartum. High pain intensity scores for women suffering from back pain indicate a poor prognosis (Robinson et al., 2010a). Olsson et al. (2012b), investigated the associations between catastrophising and LPP and between catastrophising and postpartum physical ability. A total of 242 women completed questionnaires from pregnancy to six months postnatal. Their results showed that 42.1% of women had LPP between pregnancy and 6 months postpartum. A major finding reported was that women suffering LPP during pregnancy demonstrated higher proportions of postpartum LPP and higher DRI scores at six months postpartum.

A similar pre-test and post-test control-group design approach was examined in a randomised controlled trial conducted by Nilsson-Wikmar and colleagues (2005). The authors investigated three different interventions for pregnancy-related pelvic girdle pain, where the emphasis of treatment was on the effect of different physiotherapy treatment programmes for the pain and activity of pregnant women. The authors found a significantly greater improvement of outcomes as measured by pain intensity, a reduction in median pain intensity and higher activity ability at 12 months postpartum among three groups (Nilsson-Wikmar et al., 2005). This further suggested that pain intensity related to physical activities should include the consideration of pain occurrence and pain intensity, providing tailored exercise resources and having positive attitudes towards the prognosis. Evidence from Robinson's study reported pelvic girdle pain was significantly associated with DRI at 12 weeks postpartum. Women who suffer higher pain intensity had higher DRI (Robinson et al., 2010a).

Vøllestad and Stuge (2009), investigated the prognostic factors of pelvic girdle pain at one year after delivery. Outcome measures used were the ODI and a VAS. At one year postpar-

tum, the pain intensity and disability scores had significant decreased and pelvic girdle pain was associated with body disability (Vøllestad and Stuge, 2009). Olsson together with colleagues (2012b), used questionnaires to evaluate 273 pregnant women with LPP and follow-up to six months postpartum. The findings were that higher pain intensity in women was combined with a higher DRI score and moreover, pregnant women having LPP will experience more pain and more limitations on physical ability at six months postpartum (Olsson et al., 2012b). The current PRCT study's findings were inconsistent with the findings from the above studies. Although the LPP and DRI of three groups had decreased scores over time, the Internet-based group had significantly less pain ('at past week' at six weeks) but not DRI items.

However, the value of direct comparisons of physical endurance for LPP after six weeks and four months postpartum for this PRCT study is in the recognition of LPP as a condition with potentially serious consequences. If the LPP condition affects the woman's postnatal activities, it may possibly affect her long-term health.

7.2.5 The effectiveness of an exercise programme via three instruction modes on secondary outcomes (diastasis recti)

Changes in core muscles were measured via physical examinations that include measurements of waist circumference, body weight and a diastasis recti test. In our findings, there was a significant difference among the 3 groups over time regarding body weight, waist circumference and the three levels of diastasis recti. But the comparison between groups and each time illustrated no significant difference among the 3 groups during discharge and follow-up time. The body weight and waist circumference exhibited a declining trend, the mean of body weight and waist circumference decreases by 4.4 kg and 9 cm respectively at six

weeks postpartum and by 7.1 kg and 13.8 cm at four months postpartum. The condition of postpartum weight retention was considered in the review conducted by Cheng et al. This reported a systematic review of women's postpartum weight retention in Asia. A total of thirteen articles met the inclusion criteria and Asian countries included China, Hong Kong, India, Korea, the Philippines and Taiwan. The average reported weight retention at 6 months postpartum in these studies ranged from 1.56 kg to 4.1 kg (Cheng et al., 2011).

Huang et al. (2010), in a survey of 602 women in Taiwan, compared body weight between pre-pregnancy and postpartum. Results revealed that 75.4% of them retained up to 5 kg in relation to their pre pregnancy weight (Huang et al., 2010). Huang and colleagues used a randomised controlled trial to investigate diet and physical activity intervention for preventing weight retention among Taiwanese postnatal women. In the two experiment groups, women at different timing received an individualised dietary and physical activity education plan. After six months follow-up, it has been found that, the two experiment groups had less body weight retention than the control group, with average weight retention of 2.34 and 4.06 in the experiment groups, and 5.08 kg in the control groups. This confirmed that diet and physical activity are effective for reducing post-pregnancy weight retention (Huang et al., 2011). Huang and Dai (2007), suggested that body-weight management during pregnancy and the first 6 months postpartum helped women to build a good body image and improved health-promoting behaviour and were effective in reducing obesity and the incidence of obesity-related diseases.

In the current PRCT study, the diastasis recti test followed Boissonnault and Blaschak's standardized process to measure participants at discharge, six weeks and four months postpartum (Boissonnault and Blaschak, 1988). It was the simplest way to evaluate diastasis of

the rectus abdominis muscles and measured the number of finger breadths between the medial edges of the muscles. The diastasis recti measurements were undertaken in three different places: the 4.5cm umbilicus above, umbilicus and the 4.5cm umbilicus below. The measurement result was classified as normal for any separation above, below, or at the umbilicus of two finger widths or less, and greater than two finger widths constituted a diastasis recti abdominis (Boissonnault and Blaschak, 1988). The findings of the diastasis recti test showed a significant decrease in each group over time. No statistically significant differences were found among the three groups at six weeks and four months postpartum. 60.12% of women had greater than two finger widths of rectus abdominis muscles distance in the immediate postpartum (at discharge), 3.9% and 2.8% had diastasis recti abdominis at six weeks and four months postpartum respectively. Boissonnault and Blaschak (1988), found that incidence of diastasis recti abdominis on postpartum women was reported as 53% at immediate postpartum and 36% between 5 and 7 weeks postpartum. Sperstad et al. (2016), investigated the prevalence of diastasis recti abdominis during pregnancy and 12 months after childbirth with 300 nulliparous pregnant women. Measurement of diastasis recti abdominis used hands for palpation 4.5 cm above, at and 4.5 cm below the umbilicus. The result of prevalence of diastasis recti abdominis at six weeks and 12 months postpartum were 60.0% and 32.6% respectively.

Gilleard and Brown (1996), measured six primipara pregnant women for inter-recti distance from 14 weeks of gestation to 8 weeks post birth. They found rectus abdominis muscle separation width and length changed as the pregnancy progressed. At four weeks postpartum it was reported that rectus abdominis muscle separation was reversing. The study design did not include measurements in the immediate postpartum period, so the rate of change in inter-recti distance is unknown. Hsia and Jones (2000), evaluated the inter-recti distance from

36 weeks of gestation to 12 weeks postpartum using two single case studies. The result at the immediate postpartum period suggests women during delivery of the second stage may affect reversal of the rectus abdominis muscles by very hard pushing, and moreover, the lithotomy position pressure generated from bearing down may have further stressed the anterior abdominal wall.

A longitudinal observational study by Mota et al. (2015), investigated the prevalence of diastasis recti abdominis from gestational week 35 until 6 months postpartum. It was reported that 39% of the women were diagnosed with diastasis recti abdominis at 6 months postpartum. There were no risk factors related to pre-pregnancy body mass index, weight gain, baby's birth weight or abdominal circumference. Liaw et al. (2011), investigated the natural recovery of inter-recti distance and abdominal muscle strength and endurance in women between 7 weeks and 6 months postpartum by ultrasound imaging. Measurement locations included the upper and lower margin of the umbilical ring and 2.5 cm above and below the umbilical ring with timing at 4 to 8 weeks and 6 to 8 months after childbirth. The authors found for women at six months postpartum, the inter-recti distance was improved and positively correlated with improvement in the strength of the trunk flexors (Liaw et al., 2011). Coldron et al. (2008), found strength and fascial support were impacted by a thinner, wider and longer rectus abdominis. The suggested postpartum exercise programme design would consider the inter-recti distance, rectus abdominis width, thickness and length, which may help the rectus abdominis muscles to return to normal (Coldron et al., 2008).

The disparity in methods for different studies indicates that all studies of diastasis recti abdominis after child birth should be interpreted with caution, whether using ultrasound imaging and/or a physical assessment as a method for reporting of the condition. The difference

in results could also be due to the challenge in classifying diastasis recti abdominis from a physical assessment: there is a possibility of error when palpation was made on the abdomen by the research midwife. Indeed some studies have used dial callipers for rectus abdominis diastasis measurement in their reporting (Boxer and Jones, 1997; Hsia and Jones, 2000). This was thought to add validation to the classification method. This added tool was not used in this study. The strength of the current study is that there was a single examiner (research midwife) for the physical assessment and followed the standard at every time to do the measurement twice, to ensure consistent results. The research midwife accepted a training protocol before data collection and followed the standard and testing twice at the same time, thus providing a rigorous process that avoided intra-rater reliability errors.

It was difficult to compare Phase 2 of the PRCT of the diastasis recti test findings with results from previous studies, given that different studies used different measures to compare diastasis recti outcomes. Likewise, the effectiveness of the exercise programme via three instruction modes on diastasis recti results found no significant differences between the DVD-based, Internet-based and Usual Care group.

7.2.6 Acceptability (uptake, adherence and completion rate) of an exercise programme of the three delivery modes (Objective 3)

One of the aims of the PRCT was to test the participants' acceptability (uptake, adherence and completion rate) of the three modes of delivery of the intervention. This is defined as the adherence to exercise per postpartum week, the uptake of each type of mode of delivery and overall completion rates for the three groups.

The PRCT findings confirmed that the overall completion rates of postpartum exercises at six weeks postpartum were: Internet-based group (28.9%); DVD-based group (25.8%) and Usual

Care group (22.7%). At four months follow-up, the DVD-based group had a (24.8%) completion rate; the Internet-based group (18.1%) and the Usual Care group (12.4%). Participants in the Internet-based group and Usual Care group revealed reduced completion rates regarding exercise between six weeks and four months postpartum. The completion rate demonstrated women who undertook the exercise after delivery up to four months. Compared with previous studies, no research studies could be found to demonstrate the postpartum exercise completion rates, even for the three different instruction modes.

The result of exercise adherence was reported each week, for four months in total. It showed 16 weeks of women undertaking the exercise frequencies. The postpartum exercise frequency results is published in a weekly report (there are 16 weeks). Why the study uses the weekly model to report is because Taiwanese women have a tradition where they stay indoors for a month to take care of themselves and their child, besides taking maternity leave. At the time of this study, maternity leave in Taiwan is eight weeks (Ministry of Labour, 2018) and women resume working nine weeks postpartum.

The results of the exercise adherence used a weekly report to understand if the doing-a-month period or maternity leave may be related to postpartum women undertaking exercise. The findings of the exercise adherence found no significant differences between the groups. Comparing exercise adherence in each group; the first to 16 weeks after intervention demonstrated that the postpartum exercise programme via the Internet-based instruction had greater adherence to exercise in weeks 1, 3 to 10 and 14.

The Usual Care group via the traditional leaflet that had higher adherence to exercise in weeks 2, 11 to 13 and 15. Therefore the DVD result for average exercise performed was in the middle. There was a decrease in exercise frequencies in all three groups when women

completed ‘doing-the-month’. At five weeks postpartum, the woman together with her partner will normally go to visit her family and friends to share the good news about their baby becoming a month old. This may have disrupted the exercise routine. At eight weeks, participants in all the groups showed higher adherence to the exercises. Crucially, this week was the last week of maternity leave for women who were employed. In the ninth week, the adherence to exercise was less than in the eighth week. This is the time that working women return to work. Barriers to not exercising as reported by the women included: being on child duty (51.7%), felt tired (27.5%) not interesting (13.7%) and family opposed (6.89%). These were the most common at six weeks postpartum. The reasons for not undertaking the exercise at four months postpartum were feeling tired (48.9%), child duty (38.2%) and not interested in continuing exercise (12.7%). Almost twice as many women reported feeling too tired to take the exercise at four months postpartum in relation to six weeks postpartum. Those findings were similar to previous studies reporting barriers to exercise for women such as being too tired, lack of time to exercise, childcare duties and lack of family or social support (Jenkins et al., 2006; Evenson et al., 2009b; Cramp and Bray, 2011).

Based on the Downs and Hausenblas’ (2004) study, postpartum women’s control beliefs are often challenged and obstructed by time limits, physical limitations or restrictions and tiredness/fatigue. A qualitative study by Saligheh et al. (2016), explored women’s beliefs about and experiences of physical activity and exercise during the 6 weeks to 12 months postpartum period. They found fatigue, a lack of motivation and confidence, substantial time constraints, lack of access to affordable and appropriate activities and poor access to public transport were barriers for women performing exercise in the postnatal period. In another study, non-health related intrapersonal barriers (32.7%) included low motivation, not

enough time, lack of enjoyment of being physically active, lack of childcare, costs and lack of knowledge about activity (Evenson et al., 2009a).

The current study did not explore the barriers to exercise in more depth and this is an area that requires detailed investigation in future qualitative studies. Overall, in terms of adherence between the three groups the internet-based group performed better than the DVD-based group and the Usual Care group. This suggests that women adhered to the electronic, online mode of instruction more than they did to either non electronic or electronic but not online modes of instruction. This finding may be useful in informing similar future initiatives in conjunction with other similar studies.

Harrison et al. (2016), evaluated the consumer-targeted YouTube video use of effective pain reduction strategies during infant vaccinations. Results showed that 12 months after posting onto YouTube, the video had large numbers of viewers around the world. After seeing the video, 86% of parents answered they would breastfeed during their infant's subsequent immunizations. The study by Harrison et al. (2016), ascertained that the parents get information about effective pain management strategies and about infant vaccinations via YouTube videos. McKay et al. (2001), evaluated an 8-week pilot study of using an internet-based intervention to assess diabetes patients with physical activities. 78 patients were randomly allocated to the diabetes network, active lives, physical activities intervention or an internet information-only group. The experimental group received a tailored personal physical activity programme and was assessed online for physical activity level. Internal analyses revealed a significant relationship between the extent of website use and level of improvement in physical activities. Internet-based intervention appears effective for increasing activity levels among those patients who use the service with sufficient regularity (McKay et al.,

2001). Spittaels et al. (2007), evaluated the use of an intervention delivered using a website to increase physical activity in the general population. 434 participants were allocated into three groups (website group, information group and control group). The result found a web-site-delivered intervention, including computer-tailoring, was able to increase physical activity when compared to a no intervention control group (Spittaels et al., 2007).

Motl et al. (2011), used a randomised controlled trial to examine the effect of an internet intervention based on social cognitive theory for favourably increasing physical activity among persons with multiple sclerosis. 54 participants were randomised into two groups (an Internet intervention condition or a control condition). Follow up for three months to collect the physical activity and mediator data. There was a significant result from the intervention group in physical activity over time and a large increase. The effect of the Internet intervention was mediated through a change in goal setting behaviour, and was most successful in those who did not initially engage in goal setting behaviour and those who had less severe disability (Motl et al., 2011). In this study, evidence was provided for an increase in physical activity by using both objective and self-reporting measures and feedback through a process evaluation for improving the Internet intervention in subsequent administrations (Dlugonski et al., 2011).

The use of social media technologies in health care to connect information and communication is a new type of information. Searching for and sharing information on the Internet can create new roles and new technologies with family, providers and peers, and the e-patient (Lober and Flowers, 2011). People are increasingly turning to the Internet to seek knowledge of medical conditions and treatments to make informed healthcare decisions. YouTube is a

useful resource to search for information because of the videos providing information on the pathogenesis, diagnosis, treatment and prevention of various health conditions.

The Internet provides many opportunities for consumers to gain information on health care (Madathil et al., 2015). In addition, regarding the finding of the systematic review (Phase 1), Men's study (2000), used videotapes as an instruction given to all subjects to take home. The authors supposed that it was essential to provide the women with instructions on the exercises. They believed the instructions may have influenced the women in relation to performing the exercises and moreover, believed that instructions from a physical therapist would have been far better if they comprised individual instructions. There was a similar believe with respect to the Phase 2 PRCT study design, which assumed that the postpartum women who received the exercise video could increase their exercise behaviours, in comparison to women who received instruction by way of the leaflet. However, the video has been used for many years as an instruction to help people with various conditions undertake exercises. Nevertheless, there are few studies to show the intervention has used the Internet such as YouTube to investigate healthcare, as there was a limit on the Phase 2 PRCT findings for comparison with different studies.

Conversely, the DVD-based group had lower exercise adherence than the Internet-based group and the Usual Care group (via leaflets). However, these findings are inconsistent with findings from previous studies. For example: Mahler et al. (1999), evaluated the effects on compliance with recommended lifestyle changes using two experimental videotapes with different educational approaches. 216 participants were randomly put into one of the two videotape groups prior to being discharged from the hospital or were given only the standard discharge preparation offered by the hospital. After interventions, the outcomes with

exercise compliance illustrated that the coping tape had significantly higher exercise rates at one month and significantly more strenuous exercise at three months. Findings of patients who viewed videotapes exhibited greater dietary and exercise compliance than the controls during the initial months of recovery.

Petty et al. (2006), compared the effects of quality of life and activities of daily living with chronic obstructive pulmonary disease patients. The three randomised parallel groups were a personalised videotape group, a standard education videotape group and a usual care group. It was reported that the personalised videotapes group had better conversion and retention of exercise habits. Furthermore, there was increased quality of life, lower fatigue and better compliance with a prescribed exercise regimen among subjects using the customised videotapes. Albert et al. (2007), used the short-term impact of video education and standard education for 112 heart failure patients to compare health care utilisation and self-care behaviours adherence. The video education developed self-care behaviours and self-management actions that included treatment plan overview, nutrition, exercise training and lifestyle. During the 3-month follow-up, video education patients had a significantly higher report of self-care behaviours score. The video intervention was to improve the self-care adherence. Vickers et al. (2011), assessed the impact of exercise education intervention on exercise frequency and attitudes in cardiovascular outpatients. A total of 509 participants were randomised to a DVD exercise intervention group and standard care control group. The DVD took approximately 43 minutes and the content included basic information about the benefits of exercise and encouraged the use of goal setting and other cognitive, behavioural, and motivation-enhancing techniques.

Our findings indicate the need for more research to confirm the acceptability of DVDs to convey exercise messages for postpartum women compared to Internet based mediums.

7.2.7 Discussion of theoretical framework of the development of the exercise video in Phase 2 of the PRCT

The development of the exercise video that informed the DVD-based and Internet-based modes of delivery was based on Multimedia Learning Theory. Based on the content of the postpartum exercise programme used in the leaflet (current usual care), the five steps of Multimedia Learning Theory were applied to develop the exercise video based on the use of visual as well as auditory stimuli (See Section 2.5.1). The exercise video represented the written text and images of the leaflet as colourful animations and a model demonstration of the exercises, via music and voice-over as supportive, visual stimuli. According to the Multimedia Learning Theory participants who received the video instruction, stored information as deep working memory representations which are believed to impact on the participants' exercise behaviours.

Video has the potential to improve learning in various ways. It can provide help for the learners' cognitive system. In the current PRCT study, in accordance with the cognitive theory of multimedia learning design principles, the video was created by applying three of the principles: segmentation, signalling and weeding. The video consisted of three parts which are the purpose of the exercise, benefits of postpartum exercise and motion demonstration (segmentation), cueing and summarising the main information included in the video (signalling) and removing the nonessential information (weeding). The postpartum exercise video was developed based on the contents of the existing exercise leaflet and by transforming the words and pictures to sound and animation in order to stimulate the participant's sensory

memory. When participants received and organised those sounds and images, the sounds were stored in a verbal model and images become a pictorial model (working memory) and are then internalised in the long-term memory. This study supported the hypothesis that women, receiving the video knowledge, would be influenced to implement better exercise behaviours because the evidence was that women in the DVD-based group and the Internet-based group completed the postpartum exercises to a greater extent than the Usual Care group (leaflets).

Some studies have used multimedia learning theory to produce different interventions for health care. Mohamadirizi et al. (2014), divided 100 pregnant women into two groups of learning interventions: multimedia and an illustrated booklet. The result for level of knowledge increase found a higher increase in the e-learning group compared to the illustrated booklet group. This study indicated that the courses of e-learning training improved the knowledge of pregnant women to a greater extent compared to illustrated booklet education. Szmeja et al. (2014), used DVD technology to provide dietary and lifestyle information. 1108 women were randomised into two groups (DVD group and standard materials group). The study established that the information presented in the DVD was evaluated by women in a positive manner, with most of the participants either agreeing or strongly agreeing that the information they received was easy to understand and helped them to make healthier food choices. Indeed, technology-based behavioural health interventions are shown to be cost effective, efficacious and well accepted, when compared to standard care.

As presented in Chapter 2 (Figure 3), postpartum exercise, communicated in the form of multimedia presentation such as words and animation, formulates exercise knowledge through integrating sensory memory (ears and eyes), working memory (sounds and images) and long-term memory. Exercise knowledge creates and subsequently strengthens behavioural beliefs,

normative beliefs and control beliefs. The exercise video via auditory as well as visual instruction may have an impact on the motivation of the participants to uptake and adhere to the instruction, and under the concept of control belief, these three beliefs are interactive and have an important impact on women's postpartum exercise. For the exercise adherence findings, it was reported the participants in the Internet-based group via the internet technique received the exercise programme that had more adherence to exercise than the other two groups. The result of the exercise adherence found that the DVD-based group that used the DVD player to watch the exercise video performed the exercise less than the Usual Care group that used leaflet instruction to do the exercise. Therefore, it is unclear how the theoretical foundations of multimedia learning theory has impacted on the acceptability and uptake of the postpartum exercise programme and how it affects the participant experience, or what the limitations are. Further research is required to explore the application of multimedia learning theory in the context of postpartum exercise in clinic care.

7.3 How the systematic review findings informed the PRCT study

The findings of the systematic review are described in Chapter 5 (see 5.5). The systematic review (first phase of the current study) searched eight databases (see Section 3.3.12) between 1990 and 2014 and aimed to develop an evidence base for the effectiveness of exercise interventions on postpartum LPP in the past twenty years. Although only four trials met the inclusion criteria for the systematic review, conducting the systematic review enabled the researcher to develop an understanding of the overall evidence, the lack of extensive evidence on the medium of instruction and moreover, to be informed of the methods that have been used to test the effectiveness of exercise on postpartum LPP.

Regarding the Phase 1 systematic review, the methods of delivering the interventions differed across trials, one trial in Men's study developed the videotape as an instruction. Here, women who follow the videotape perform exercises at home without supervision (Mens et al., 2000). Two trials were specialist exercise programmes training postpartum women, Stuge et al (2004a; 2004b), used an individualised exercise programme (specific training of the transversely orientated abdominal muscles, the gluteus maximus, the latissimus dorsi and the oblique abdominal muscles) performed primarily at home with guidance provided by the physical therapist. Gutke's study were given a specific stabilising exercise programme (focused on the transversely abdominal, the lumbar multifidus and the pelvic floor muscles), plus home training with individual guidance and adjustment of the exercise programme every two weeks by one of two treating physiotherapists (Gutke et al., 2010b). Chaudry's study trained postpartum women with treatment sessions (Core stabilisation exercises along with postural correction in different positions) in hospital (Chaudry et al., 2013).

Regarding the systematic review (Phase 1) at methods of delivering the interventions, which informed the PRCT study (Phase 2), it was the only trial (Mens et al., 2000) that used a video to deliver instructions. This was the inspiration for the PRCT study design of the DVD-based group. Additionally, the systematic review also informed the choice of study for the sampling techniques and measurement tools. The studies identified in the systematic review informed the PRCT sample size and attrition rate (Stuge et al., 2004b) with statistical power set at 80% (Mens et al., 2000). Moreover, the sample size loss rate in Stuge's study had a refuse-to-participate rate of 26.1% (Stuge et al., 2004b). This study has taken this rate into the sample size loss rate.

As mentioned previously, the systematic review also informed the choice of the study instruments for the current PRCT. The VAS measurement tool, which was used in the PRCT, was employed to assess pain intensity in all the four trials included in the systematic review. Furthermore, the VAS was used to assess pain intensity in the morning and in the evening (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b) and also assessed current pain and average pain during the previous week (Gutke et al., 2010b). The PRCT study which used the VAS as a measurement tool to assess LPP at current pain and past week primarily referred to Gutke's study (2010b) to gain ideas. Although the four trials did not report the VAS reliability, the VAS tool is extensively used for its simplicity and adaptability to a broad range of populations and settings (Gillian et al., 2011).

Bellamy et al. (1998), used the VAS to test patients about the intensity of pain in the reference knee and reported high internal consistency (Cronbach's alpha 0.81) of the tool. Bijur et al. (2011), assessed the reliability of VAS in measuring acute pain, and found the tool highly reliable (r= 0.97; 95% CI: 0.96 to 0.98). The internal consistency of VAS in the PRCT study (Phase 2), was determined to be of high internal consistency (Cronbach's alpha 0.79).

The crucial difference between the trials included in the systematic review and the current study was the pragmatic RCT design, seeing as none of the trials involved a pragmatic design. However, the evidence from the systematic review on the methodological aspects and the effectiveness of exercise interventions on postpartum women provided vital information and knowledge. The systematic review also indicated a substantial gap of knowledge in the area of mode of instruction for exercise for postpartum women.

7.4 Summary

The current study involved two phases with Phase 1 being the systematic review of RCTs on the effectiveness of exercise on LPP among postnatal women and phase 2 being the PRCT of the effectiveness of the three modes of instruction (DVD-based, Internet-based and Usual care). Four RCTs met the inclusion criteria for the systematic review, which informed the PRCT study in terms of methodological approach and in terms of the indications of the substantial knowledge gap in the area of mode of instruction for exercise for postpartum women.

The pragmatic trial in Phase 2 assessed the effectiveness and acceptability of an exercise programme delivered using DVD, internet or leaflet (usual care), on LPP among postnatal women. The postpartum exercise programme was developed as a video based on the contents of the leaflet using Multimedia Learning Theory and was delivered using DVD and the Internet. The PRCT looked at outcomes at six weeks and four months from the beginning of the intervention. The Internet-based intervention was found to be more effective for the exercise on LPP ('at past week'). In relation to the physical endurance outcomes, the DVD-based group reported less difficulty than the other two groups in performing the standing bent over a sink item in daily life at six weeks postpartum. The Internet-based group adhered more to the schedule of the exercise than the DVD-based group and Usual Care group. As per the overall findings, it can be suggested that the Internet is an effective medium to encourage women for exercise and the use of exercise videos delivered via Internet-based mediums can serve as potential enhancements for the management of LPP on postpartum women in Taiwan. Thus, practitioners working with postpartum women in Taiwan and other

similar settings could consider incorporating these practices into the delivery of some of their health care services.

Chapter 8

Conclusion and Recommendations

This chapter presents the key findings of the study and discusses limitations, recommendations and future directions.

The aim of the study was to assess the acceptability and effectiveness of an exercise intervention delivered through DVD and internet for postpartum women with LPP in Taiwan, in comparison to the traditional instruction via the use of leaflets. The objectives of the study were:

1) To develop an evidence base for the effectiveness of exercise interventions on postpartum LPP.

2) To compare the effectiveness of three methods of instruction of exercise on postpartum LPP: DVD based, Internet based and leaflet based.

3) To compare the acceptability (uptake, adherence and completion rate) of three modes of delivery: DVD-based, Internet-based and leaflet based.

The first objective was achieved through the systematic review on the effectiveness of exercise interventions on postpartum LPP. The second and third objectives were met via the use of a PRCT.

8.1. Key Findings

8.1.1. Findings from the systematic review

- Five articles originating from four trials were included in the review from 1278 articles yielded by the search strategy.
- Three of the articles were found to be of 'good' methodological quality. One trial was rated as 'fair' in terms of methodological quality.
- Interventions in the four trials used specific or core stabilisation exercise programmes and diagonal trunk muscle systems training programmes.
- The methods of delivering the interventions differed across trials, but there was no concrete evidence concerning the acceptability of exercise delivered using different methods of delivery
- Women who received 20 weeks of training in a core stabilisation exercise programme reported significant reductions in pain intensity in the morning and evening during the intervention period and at 1- and 2-year follow-ups, with a better reduction of pelvic girdle pain in the intervention group compared to the control group.
- The specific stabilisation exercise of two times per day training, produced significant difference in reported pain frequency between the intervention and control groups at 3-month follow-up, in favour of the intervention group. However, no differences between the groups with respect to pain intensity were found.
- Women following the eight-week diagonal trunk muscle systems training programme, scored better than the control groups with respect to changes in the gluteal pain provoked by the PPPP test scores on the right side.

As stated in the literature review (Mens et al., 2000; Stuge et al., 2004a, 2004b; Gutke et al., 2010b; Chaudry et al., 2013), postnatal exercise is routinely recommended to women. This review indicates a paucity of methodologically rigorous research studies to make reliable conclusions with respect to the effectiveness of physical exercise on LPP amongst postnatal women. An individual-tailored programme which used stabilising exercises involving all relevant muscles, produced positive results for LPP and other related variables (Mens et al., 2000; Stuge et al., 2004a, 2004b). Further, high quality randomised trials with controlled co-interventions and standardised outcome measures are needed to identify the most effective combination of exercise elements that can have an effect on reducing LPP and improve associated health and well-being factors.

While physical therapy involving exercise programmes, tends to be one of the treatment approaches used to relieve LPP, ascertaining its effectiveness is a matter of importance to policy, practice and research in the area.

8.1.2. Findings from the pragmatic controlled trial

- The Internet-based exercise instruction has significantly reduced LPP ('at past week') at six weeks postpartum.
- The DVD-based exercise instruction has significantly reduced DRI (the standing bent over a sink item) at six weeks postpartum.
- The Internet-based instruction had higher acceptability adherence than the leaflet instruction and DVD-based instruction.

The PRCT measured LPP, physical endurance and abdominis diastasis recti of core muscles. The outcome measures were rated via VAS, DRI and diastasis recti. A comparison of out-

comes in relation to baseline data illustrated no significant difference between the three groups. After intervention, women in the Internet-based group were found to have reduced LPP of 'past week' at six weeks postpartum ($p< 0.005$). Women in the DVD-based group had less difficulty in the standing bent over a sink DRI score at six weeks postpartum ($p< 0.008$). Women's acceptability of exercise was much higher when the Internet is used as the communication tool, compared to instruction via DVD or leaflet. One of the findings is that LPP has a direct relationship with DRI; which means women with greater pain find it more difficult to deal with daily activities. When applying repeated measures ANOVA analysis to understand the changes of time and groups, it was found that the scale of LPP, DRI and diastasis recti decreases with time. Therefore, it was concluded that internet is an effective medium to encourage women to exercise and help them reduce LPP.

The findings of this thesis can inform policy and practice to improve LPP and reduce unnecessary admissions/referrals for treatment.

8.2 Limitations

The systematic review process uses rigorous, systematic, and transparent methods to evaluate the available data and reduce bias in the subsequent findings (Bartolucci and Hillegass, 2010). The narrative synthesis of the systematic review in this study only allowed for an aggregate estimation of the effectiveness of the three interventions. A meta-analysis was not feasible for making estimates of strength of effect due to the wide variation in intervention components, outcome measures, follow up times and study quality among the selected studies. The restriction on RCTs as an inclusion criterion might have resulted in the exclusion of non-randomised and other experimental studies that could have yielded useful findings.

The restriction to articles published in English could have also resulted in the exclusion of articles in other languages although this is likely to be minimum. However, the randomised controlled trial is deemed to be the most rigorous method to determine the presence of a cause-effect relationship between an intervention and an outcome, and therefore the highest quality of evidence to be included in a systematic review.

As RCTs may not be used to evaluate population health interventions, the researchers have to consider, trade-offs of design such as sample size, participant contamination, time available for follow-up, threats to external validity, relative costs, and ethics of randomisation and non-consent (Sanson-Fisher et al., 2007). In this study, the sample size design chose the medium effect size f = .25. The reason to use the medium effect size was to avoid having an underpowered study. Similarly, the small effect size is one in which there is a real effect, though the small effects will require greater resources in contrast to the than large effects. In Phase 2 of the PRCT study, the sample size determination was considered 26.1% refuse-to-participate rate (Stuge et al., 2004b) and 24.3% primipara caesarean section (Shin Kong Medical Centre Hospital in 2014). In Phase two of the PRCT study, the loss rate was predicted to be 50%. In fact, the actual loss rate determined at the completion of the study was 50.71%**.** It should be mentioned that continuity and tracking are considered the principal challenges concerning sample size and time available for the follow-up of this study. It is difficult to track the participants once they leave hospital for home, seeing as they may not return to hospital for tests. For that reason, data have been lost during the tracking process.

Conversely, threats to the external validity of randomised control trials design are the lack of generalizability or low external validity. The reasons for this may be that the participants are uncharacteristic and may not represent the entire population. In my study, I only recruited

participants from one hospital in North Taiwan and therefore only weak generalisations can be made in relation to the population of Taiwan.

Furthermore, the quantitative survey used in the study may not adequately capture the women's feelings and views vis-à-vis the exercise intervention and its modes of instruction.

8.3 Recommendations

The main recommendation resulting from the systematic review is that further primary studies are needed, such as high quality randomised trials with controlled co-interventions and standardised outcome measures, to identify the most effective combination of exercise elements that can have an effect on reducing LPP and improve associated health and well-being factors.

According to the findings of this study, the prevalence of postpartum LPP at past week were 57.8% of 128 participants at six weeks postnatal (DVD-base group: 14.9%, Internet-based group: 20.3%, Usual Care group: 22.7%) and 34.3 % of 105 participants at four months after delivery (DVD-base group: 12.4%, Internet-based group: 7.7%, Usual Care group: 14.3%). This indicates that LLP is common among postpartum women in Taiwan. However, there does not appear to be any accurate estimates regarding postpartum LPP in Taiwan. It is important to advance research in the area of prevalence of LPP to assess the magnitude of the problem and take action to improve services, as this is important for the women, their families and the healthcare system. Similarly, it is imperative to provide (the women and the healthcare staff) with information about exercise to help women reduce the LPP as soon as possible.

Currently, in Taiwan a new mother receives verbal advice from nurses prior to her discharge from hospital and a leaflet which describes a set of exercises with which to manage postpartum lumbar and pelvic pain. Nurses also instruct mothers in relation to postnatal exercises with the assistance of the leaflet. This research has established that women who received a leaflet had low interest to do exercise. The study provides some evidence that alternative methods, especially the method of internet based instruction may improve uptake and adherence and also improve clinical outcomes.

Currently, there is emphasis on providing care to pregnant women and then the new born rather than to women postpartum (WHO, 2015). A step change towards a direction to provide improved care to postpartum women would be a pre-requisite for further research in this area. Conversely, the findings of this study provide some evidence that improved outcomes for LPP are possible, which could be a trigger for a wider consideration of the role of exercise intervention and its delivery in the public health agenda.

8.4 Future research

- The current study has not investigated the effectiveness of the contents of the exercise programme as such on LPP and this is an area for future research. High quality randomised trials with controlled co-interventions and standardised outcome measures are required to identify the most effective combination of exercise elements that can have an effect on reducing LPP and improve associated health and well-being factors.
- The quantitative survey used in the study may not adequately capture the women's feelings and views about the exercise intervention and its modes of instruction. Qualitative and mixed method techniques can be applied in future research, to under-

stand more about women's feelings, views and experiences with regard to LPP and postpartum exercise.

- The current study did not explore the barriers to exercise among postnatal women in more depth. This is an area that requires detailed investigation in future qualitative and quantitative studies.
- Further research is required to explore the application of multimedia learning theory in the context of postpartum exercise in clinic care.
- Future research is also required to establish the acceptability and effectiveness of DVDs in comparison to internet for delivering health related messages.

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Appendices

Appendix 1: Random sample list

001: Group 1	051: Group 2	101: Group 2	151: Group 1	201: Group 1
002: Group 3	052: Group 3	102: Group 3	152: Group 3	202: Group 1
003: Group 2	053: Group 1	103: Group 2	153: Group 1	203: Group 3
004: Group 1	054: Group 1	104: Group 3	154: Group 3	204: Group 1
005: Group 2	055: Group 2	105: Group 3	155: Group 3	205: Group 3
006: Group 2	056: Group 2	106: Group 3	156: Group 3	206: Group 3
007: Group 3	057: Group 3	107: Group 2	157: Group 1	207: Group 2
008: Group 1	058: Group 3	108: Group 2	158: Group 1	208: Group 1
009: Group 2	059: Group 2	109: Group 1	159: Group 1	209: Group 1
010: Group 1	060: Group 2	110: Group 1	160: Group 3	210: Group 3
011: Group 2	061: Group 3	111: Group 3	161: Group 3	211: Group 3
012: Group 2	062: Group 3	112: Group 3	162: Group 1	212: Group 1
013: Group 3	063: Group 3	113: Group 3	163: Group 2	213: Group 1
014: Group 1	064: Group 2	114: Group 1	164: Group 1	
015: Group 1	065: Group 1	115: Group 1	165: Group 3	Group1: DVD-based Group
016: Group 3	066: Group 1	116: Group 3	166: Group 2	Group2: Internet-based Group
017: Group 3	067: Group 3	117: Group 1	167: Group 3	Group3: Usual Care Group
018: Group 2	068: Group 1	118: Group 1	168: Group 1	
019: Group 3	069: Group 1	119: Group 3	169: Group 3	
020: Group 2	070: Group 1	120: Group 1	170: Group 1	
021: Group 3	071: Group 1	121: Group 3	171: Group 2	
022: Group 2	072: Group 2	122: Group 3	172: Group 2	
023: Group 1	073: Group 3	123: Group 1	173: Group 1	
024: Group 3	074: Group 3	124: Group 2	174: Group 1	
025: Group 3	075: Group 3	125: Group 2	175: Group 3	
026: Group 2	076: Group 3	126: Group 3	176: Group 3	
027: Group 1	077: Group 3	127: Group 2	177: Group 2	
028: Group 2	078: Group 3	128: Group 3	178: Group 2	
029: Group 2	079: Group 3	129: Group 2	179: Group 2	
030: Group 1	080: Group 2	130: Group 2	180: Group 2	
031: Group 3	081: Group 1	131: Group 2	181: Group 2	
032: Group 1	082: Group 2	132: Group 1	182: Group 1	
033: Group 2	083: Group 1	133: Group 1	183: Group 2	
034: Group 2	084: Group 1	134: Group 3	184: Group 3	
035: Group 2	085: Group 1	135: Group 1	185: Group 1	
036: Group 1	086: Group 2	136: Group 3	186: Group 1	
037: Group 2	087: Group 2	137: Group 3	187: Group 2	
038: Group 1	088: Group 3	138: Group 2	188: Group 3	
039: Group 2	089: Group 3	139: Group 1	189: Group 3	
040: Group 2	090: Group 1	140: Group 1	190: Group 3	
041: Group 2	091: Group 1	141: Group 2	191: Group 2	
042: Group 1	092: Group 2	142: Group 2	192: Group 2	
043: Group 2	093: Group 3	143: Group 1	193: Group 2	
044: Group 3	094: Group 2	144: Group 1	194: Group 2	
045: Group 2	095: Group 1	145: Group 3	195: Group 3	
046: Group 1	096: Group 3	146: Group 2	196: Group 2	
047: Group 1	097: Group 2	147: Group 1	197: Group 3	
048: Group 3	098: Group 1	148: Group 1	198: Group 2	
049: Group 2	099: Group 1	149: Group 3	199: Group 2	
050: Group 1	100: Group 3	150: Group 2	200: Group 2	

Appendix 2: Exercise programme (an English translation of the components)

Part 1: Purpose of the exercise		
• To promote the recovery of maternal physical function. • To help maternal pelvic ligament arrangement recovery, abdominal and pelvic muscle function recovery. • To improve the buttocks, abdomen, compaction of the chest muscles and help the postpartum body restore.		
Part 2: Exercise instructions		
Methods	Timing	Purpose
1. Abdominal breathing exercises Motions: Lay flat. Close your mouth and inhale deeply through your nose. Exhale slowly while relaxing your abdominal muscles. Repeat these steps 5-10 times.	The day after giving birth.	To contract the abdominal muscles.
2. Head and neck exercises Motions: Lay flat. Raise your head and try to touch your chest with your chin. Allow the other parts of your body to remain flat and slowly return to your original position. Repeat these steps 10 times.	2-3 days after giving birth.	To contract the abdominal muscles and neck muscles, as well as stretch the muscles in the back.
3. Breast exercises Motions: Lay flat with your arms resting on each side. Raise your arms straight up, hold your arms parallel to each other and bring your palms together. Then allow your arms to rest flat above your head, raise them up again and return to the original position. Repeat these steps 10 times.	2-3 days after giving birth.	To help the breasts to recover and prevent flabby and sagging breasts.

4. Leg exercises Motions: Lay flat. Raise your right leg without the help of your arms. Keep your leg in line with your body and slowly lower your leg back into a resting position. Switch legs and repeat the same steps. Repeat these steps 10 times.	8 day after giving birth.	To encourage the uterus and abdominal muscles to contract and help mothers recover their shapely legs.
5. Gluteus exercises Motions: Lay flat. Raise and bend your left leg at the knee. Bring your knee up to meet your stomach, straighten your leg and lower it back into the original position. Switch legs and repeat the same steps. Repeat these steps 5-10 times.	8 days after giving birth.	To encourage the gluteus and leg muscles to contract.
6. Vaginal contraction exercises Motions: Lay flat. Bend your knees so that your calves rest perpendicular to the floor, open your legs the same width as your shoulders and then use your gluteal muscles and shoulder muscles to raise your pelvis up at an angle. Bring your knees back together and then count to three. Open your legs and lower your pelvis back into the original position. Repeat these steps 10 times.	10 days after giving birth.	To encourage muscle contractions in the vagina and to prevent the uterus, bladder and vagina from descending.
7. Knee-to-chest exercises Motions: Get down onto your hands and knees. Hands should be placed directly under the shoulders and the knees should be placed underneath the hips. Slightly move your knees backward and outward. Lower your chest to the floor so that it is essentially flat. Be sure that your bottom is in the air and that your knees are slightly behind your bottom.	14 days after giving birth.	To help uterus contractions.
8. Abdominal muscle exercises	14 days after giving	To strengthen

Motions: Lay flat. Place your hands behind your neck, then use your abdominal and back muscles to sit up. Use your palms to touch your legs and then slowly lay back down. Repeat these steps 5-10 times and as your stamina improves you may increase the repetitions to 20.	birth.	the abdominal muscles and reduce flab on the stomach.

Part 3: Things to remember regarding postpartum exercises:

- Empty your bladder before exercising
- Avoid exercising one hour before and after a meal.
- Invest in a good support bra.
- You should do your exercises on a hard surface such as a firm bed, tatami cushion or on the floor.
- You should breathe deeply and keep your motions unhurried while exercising.
- Make sure you drink lots of water to replenish yourself, especially when breast-feeding.
- Listen to your body. If you're feeling tired, go easy on yourself. Try not to push yourself until you feel ready.
- If you start to feel light headed and nauseous, or notice a change in the colour of your vaginal discharge, consult your doctor.

Appendix 3: Postpartum exercise leaflets

產後運動

壹、目的：
一、促進產婦身體功能運作的恢復。
二、協助產婦骨盆韌帶排列恢復，腹部及骨盆肌肉群功能之恢復。
三、可收縮臀部、腹部、鼠蹊部較鬆弛之肌肉，恢復產後身材之優效。

貳、時間及做法：
一、凱格爾式運動
目的：使陰道肌肉收縮，預防子宮、膀胱、陰道下墜。
時間：產後第一天，每日可重複多次，坐、站、平躺時皆可做。
做法：如忍大小便一般的收縮會陰，尿道及肛門張力收縮5秒後，慢慢放鬆所有肌肉。

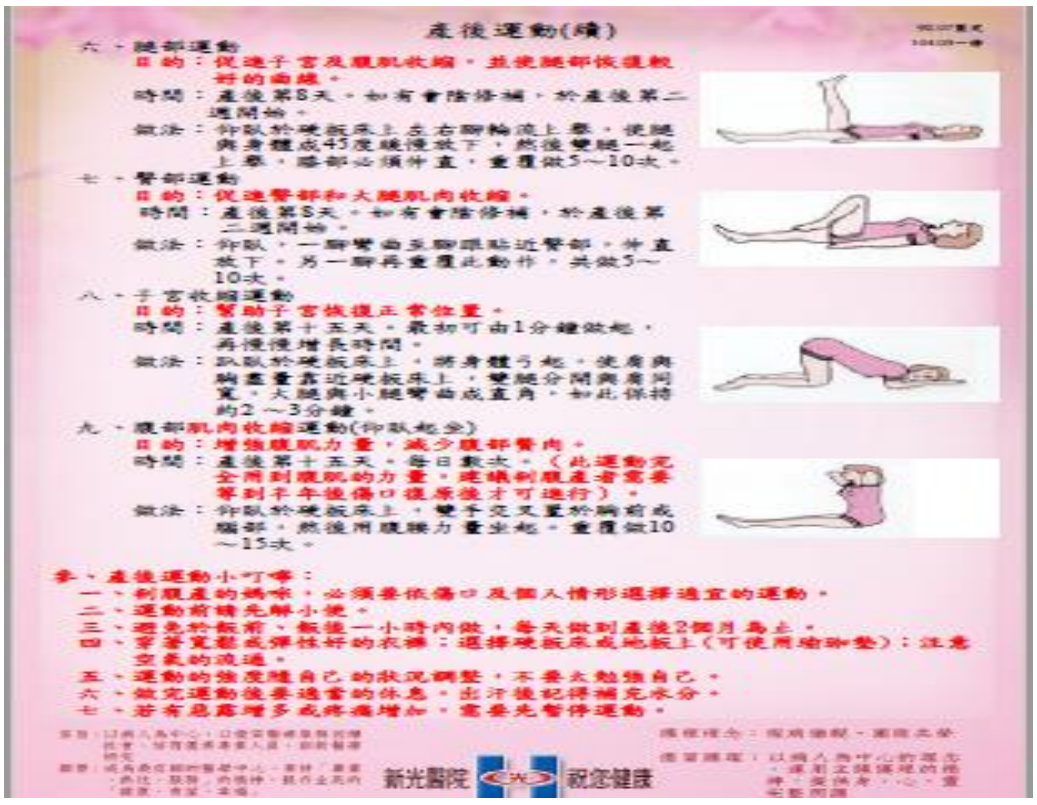
二、腹式呼吸運動
目的：收縮腹肌
時間：產後第3天，早晚兩次，每次5-10次。
做法：仰臥→慢慢吸氣→縮小腹，胸部擴大→由口慢慢呼氣。

三、乳部運動
目的：使乳房恢復彈性，預防鬆弛下垂，也可使乳腺更暢通。
時間：產後第2～3天，早晚一次，每次5-10次。
做法：兩臂向左右伸展→上舉至兩手相遇→放回原處。

四、陰道、骨盆底收縮運動
目的：使陰道肌肉收縮，預防子宮、膀胱、陰道下墜。
時間：產後第3天，每日可重覆多次。
做法：仰臥，然後將臀部抬離地板，兩膝合併兩足分開，同時收縮臀部肌肉1-2分鐘。

五、頸部運動
目的：收縮腹肌，使頸部和背部肌肉舒展。
時間：產後第4天，早晚各一次，每次5-10次。
做法：仰臥於硬板床上→抬高頸部，兩眼直視腹部約10～15秒，同時收縮腹肌→回復原來姿勢。

新光醫院 祝您健康



產後運動(續)

六、腿部運動
目的：促進子宮及腹肌收縮，並使腿部恢復較好的曲線。
時間：產後第8天，如有會陰修補，於產後第二週開始。
做法：仰臥於硬板床上左右腳輪流上舉，使腿與身體成45度緩慢放下，然後雙腿一起上舉，膝部必須伸直，重覆做5～10次。

七、臀部運動
目的：促進臀部和大腿肌肉收縮。
時間：產後第8天，如有會陰修補，於產後第二週開始。
做法：仰臥，一腳彎曲至腳跟貼近臀部，伸直放下，另一腳再重覆此動作，共做5～10次。

八、子宮收縮運動
目的：幫助子宮恢復正常位置。
時間：產後第十五天，最初可由1分鐘做起，再慢慢增長時間。
做法：臥臥於硬板床上，將身體弓起，使肩與胸部貼近硬板床上，雙腿分開與肩同寬，大腿與小腿彎曲成直角，如此保持約2～3分鐘。

九、腹部肌肉收縮運動(仰臥起坐)
目的：增強腹肌力量，減少腹部贅肉。
時間：產後第十五天，每日數次。（此運動完全用到腹肌的力量，疼痛剖腹產者需要等到半年後傷口復原後才可進行）。
做法：仰臥於硬板床上，雙手交叉置於胸前或腹部，然後用腹肌力量坐起，重覆做10～15次。

參、產後運動小叮嚀：
一、剖腹產的媽咪，必須要依傷口及個人情形選擇適宜的運動。
二、運動前請先解小便。
三、避免於飯前、飯後一小時內做，每天做到產後2個月為止。
四、穿著寬鬆或彈性好的衣褲；選擇硬板床或地板上（可使用瑜珈墊）；注意空氣的流通。
五、運動的強度隨自己的狀況調整，不要太勉強自己。
六、做完運動後要適當的休息，出汗後記得補充水分。
七、若有息露增多或疼痛增加，需要先暫停運動。

新光醫院 祝您健康

Appendix 4: Questionnaires

1. Demographic Information Form

Instructions: Please provide a response for each of the following questions:

1). What is your age? _____

2). What is your marital status?

□Single □Married □ Separated □Divorced □Widowed

3). What is your height? _____

4). What is your weight? _____(now)_____(before pregnancy)

5). What is the highest level of education you have completed?

□Primary School □Secondary School □High School □College

□Bachelor's degree □Master's degree □Doctoral degree

□Professional degree (MD, JD, etc.) □Other:_____

6). Employment Status:

□Fulltime □Part time □Retired □Unemployed

7). Did you do any exercise before pregnancy?

□ Yes (please describe which kind of exercise):_____

_____

□ No

8). Do you do any exercise during pregnancy?

□ Yes (please describe which kind of exercise): _____

_____

□ No

2. Lumbar pelvic pain intensity questionnaire

1) Please describe how you felt the back or pelvic pain during past week and make a mark (x) one point on the line.

No pain

The worst imaginable pain'

1.1) Type of pain (please tick in the box, multiple choices)

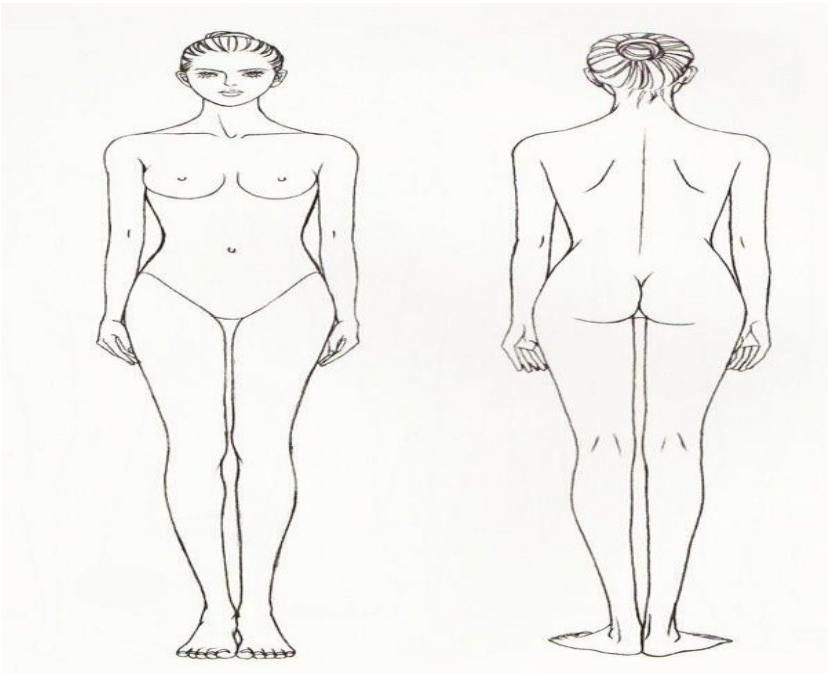
□ Dull/ aching □ Burning

□ Numbness □ Stabbing/ cutting

□ Tingling □ Cramping

□ Other (please briefly explain): _____

1.2)Pain locations (please drawing of the pain area)



2) Please describe how you feeling the back or pelvic pain recently and making a check mark (x) one point on the line.

No pain

The worst imaginable pain'

2.1) Type of pain (please tick in the box, multiple choices)

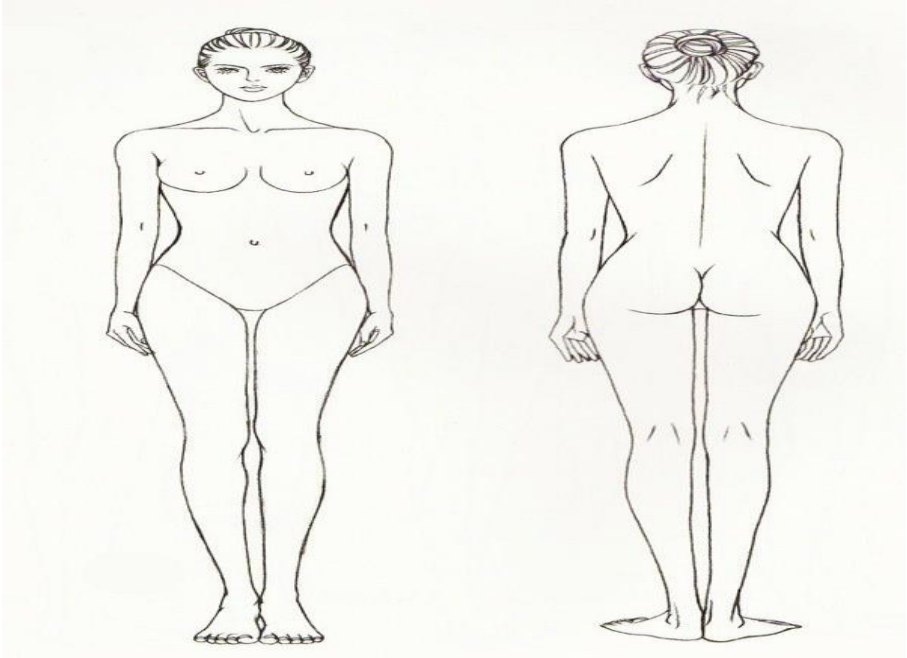
□ Dull/ aching □ Burning

□ Numbness □ Stabbing/ cutting

□ Tingling □ Cramping

□ Other (please briefly explain): _____

2.2) Pain locations (please drawing of the pain area)



2.3) If your back or pelvic pain feeling is increasing, could you please tick the possible reason?

□ Carrying a child □ Heavy lifting □ Reduced activity

□ Sleep reduction □ Tired □ Incorrect posture □ Sedentary

□ Other (please briefly explain): _____

3. The disability rating index questionnaire

Please describe how you felt during the past week by making a check mark (x) one point on the line. Please answer all the questions.

1) Dressing (without help)

Without difficulty **Not at all**

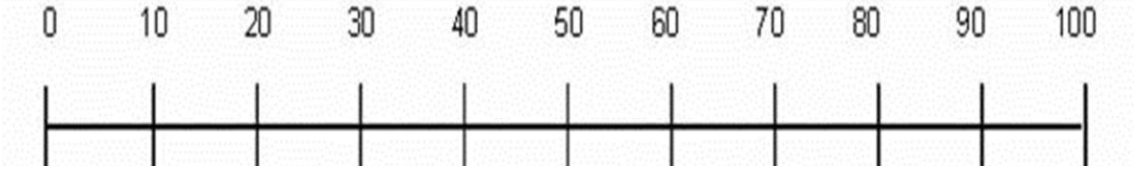
2) Out-door walks

Without difficulty **Not at all**

3) Climbing stairs

Without difficulty **Not at all**

4) Sitting longer time



Without difficulty **Not at all**

5) Standing bent over a sink

Without difficulty **Not at all**

6) Carrying a bag

Without difficulty **Not at all**

7) Making a bed

Without difficulty **Not at all**

8) Running

Without difficulty **Not at all**

9) Light work

Without difficulty **Not at all**

10) Heavy work

Without difficulty **Not at all**

11) Lifting heavy objects

Without difficulty **Not at all**

12) Participating in exercise/sports

Without difficulty **Not at all**

Appendix 5: physical examination record by investigators

Date	
Waist circumference	cm.
Body weight	Kg.
Diastasis Recti	Finger.

Signature:_____

Appendix 6: Self- record sheet

Date / Item							
Frequency of exercise (please tick on the box everyday)							
1							
2							
3							
If more than 3 please write down the number.							
0 (If you do not do exercise please explain the reason)							
Duration of exercise (Please to count time of daily exercise and then tick on the box)							
< 30 minutes							
30 minutes ~ 60 minutes							
60 minutes ~ 90 minutes							
90 minutes ~ 120 minutes							
>120 minutes							
Method of exercises (Please tick which exercise you have been done)							
Abdominal breathing exercises							
Head and neck exercises							
Breast exercises							
Leg exercises							
Gluteus exercises							
Vaginal contraction exercises							
Knee-to-Chest exercises							
Abdominal muscle exercises							
Other exercise please write down the name of exercise							

Appendix 7: Ethics approval letter (Shin Kong Medical Centre Hospital Ethics Committee)

版本：第六版　　修訂日期：101.02.28

新光醫療財團法人
新光吳火獅紀念醫院
SHIN KONG WU HO-SU MEMORIAL HOSPITAL
台北市士林區文昌路95號
TEL：886-2-28332211
E-mail：IRB@ms.skh.org.tw
Fax：886-2-28389428

人體試驗審查委員會

同意臨床試驗證明書

試驗計畫名稱：台灣產後婦女對影音光碟及網路運動型態的接受度及效益
計畫書版本/日期：Version 2，2014-10-30
計畫書編號/本會審查編號：20141005R
試驗總主持人：護理部/黃美茬
共同主持人：貝德福得郡大學/曾沛青
受試者同意書版本/日期：Version 3，2014-12-18
主持人手冊/日期：NA
通過會期：No.12/ 2014-12-11
試驗有效期限：2014-12-25 至 2015-12-24
期中報告繳交期限：2015-06-24、2015-12-24
期末報告繳交期限：2016-02-24
其他：問卷 Version 2，2014-10-30

Institutional Review Board

Approval of Clinical Trial

Protocol Title：Acceptability and effectiveness of DVD and internet based exercise regimes among postpartum women in Taiwan.
Protocol Version/Date：Version 2，2014-10-30
Protocol No./IRB No.：20141005R
Chief Principal Investigator：Mei-Zen Huang
Co-principal investigator：University of Bedfordshire / Pei-Ching Tseng
Informed Consent Form/Date：Version 3，2014-12-18
Investigator's Brochure/Date：NA
Board Meeting/Approval Dated：No.12/ 2014-12-11
Study Approval Expires Dated：2015-12-24
Mid-Term Report Submission Deadline：2015-06-24、2015-12-24
Final Report Submission Deadline：2016-02-24
Others：問卷 Version 2，2014-10-30

The above study is approved by the Institutional Review Board on 2014-12-11.

在有效期屆滿之前，計畫主持人應向本委員會規定時間提出期中報告，並於計畫完成時繳交結案報告，若屆時尚未完成，應重新申請，該計畫任何部分若欲更改，需向本委員會重新提出申請。計畫主持人對受試者任何保具有危險而且未能預期之問題，例如：對藥物、放射性元素或對醫療器材產生嚴重或非預期不良反應等，需立即向本委員會提出書面報告。

本院人體試驗委員會之組織與執行皆符合 ICH-GCP
The Institutional Review Board of Shin Kong Wu Ho-Su Memorial Hospital performs its functions according to written operating procedures and complies with GCP and with the applicable regulatory requirements.

Yours sincerely,
Gong-Jhe Wu, M.D., Ph.D.
IRB Chairman
Shin Kong Wu Ho-Su
Memorial Hospital
Taiwan R.O.C.

審查案號 20141005R_B
製發日期：2014-12-31 104. 1. 16 更新

Appendix 8: Ethics approval letter (Institute for Health Research Ethics Committee)

University of Bedfordshire
Institute for Health Research
Putteridge Bury
Hitchin Road
Luton
Beds LU2 8LE

5 February 2015

Pei-Ching Tseng
Student number: 1323269

Dear Pei-Ching Tseng

Re: IHREC Application No: IHREC452

Project Title: Acceptability and effectiveness of DVD and Internet based exercise regimes among postpartum women with lumbopelvic pain in Taiwan

The Ethics Committee of the Institute for Health Research has considered your revised application and has decided that the proposed research project should be approved with no further amendments.

Please note that if it becomes necessary to make any substantive change to the research design, the sampling approach or the data collection methods a further application will be required.

Yours sincerely

Dr Yannis Pappas
Head of PhD School, Institute for Health Research
Chair of Institute for Health Research Ethics Committee

Appendix 9: Consent form and Participant information sheet

Participant Consent Form

Title of Project:
Acceptability and effectiveness of DVD and Internet based exercise regimes among postpartum women with lumbopelvic pain in Taiwan

Name of Researcher: Pei-Ching Tseng (Supervisor: Dr Shuby Puthussery)

	Please initial the boxes	
	YES	**NO**
I confirm that I have read and understood the information sheet given to me by the researcher.	☐	☐
I confirm that I have had the chance to ask questions.	☐	☐
I understand that taking part is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.	☐	☐
I understand that relevant sections of data collected during the study, may be looked at by the researcher and her academic supervisors at the University of Bedfordshire.	☐	☐
I agree for the researcher to contact me after my delivery, for consideration to participate in a 3 month follow up. My contact details are inserted below.	☐	☐
I agree to take part in the above study.	☐	☐

Name of Participant (print)_____Signature _____Date:

Researcher (print) _____Signature_____Date:

To be completed by researcher only
Research Site_____
Participant Identification Number_____

University of Bedfordshire

Participant Information Sheet

Acceptability and effectiveness of DVD and Internet based exercise regimes among postpartum women with lumbopelvic pain in Taiwan

My name is Pei-Ching Tseng. I am a research student, with the University of Bedfordshire in the United Kingdom and I would like to invite you to participate in a research study which forms part of my PhD. Whether or not you take part is your choice. If you do not wish to join in, you do not have to give a reason and the care you receive will not be affected. If you decide to take part but change your mind later, you can withdraw from the study at any time.

This Participant Information Sheet will help you decide if you would like to participate in the study. It explains why I am undertaking the research, what your participation would involve, what the benefits and risks to you might be, and what will happen once the study ends. I will complete this information sheet with you and answer any questions that you may have. You do not have to decide today whether or not you will participate in this study, although before you make a decision you may want to discuss the study with other people, such as family, friends or healthcare providers. Feel free to do this and if you have any questions please contact me on (phone: +447720748880) or (email: pei-ching.tseng@study.beds.ac.uk).

If you agree to participate in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep.

This document is four pages long, including the Consent Form. Please make sure you have read and understood all the pages.

What is the purpose of the study?

Back pain is a common problem amongst pregnant and postnatal women. For many women, pregnancy progresses well; however, during pregnancy the female body must make several physiological, anatomical and endocrine changes, which often make women feel uncomfortable, anxious and distressed. These changes include: musculoskeletal disorders, pain, and even oppression injuries, etc. Although these phenomena often ease after delivery, in the postpartum period, some women continue experiencing back pain. Consequently, various exercise treatments have been developed to manage back pain following birth. The aim of the study is to assess the acceptability and effectiveness of exercise treatments on postpartum back pain in Taiwanese women. Your contribution to the study will allow us to develop our work in this important area. However, before you decide whether or not to participate; it is important for you to understand what participation in the study will mean for you.

What will I have to do if I participate?

If you agree to take part, before labour, you will be asked to complete some forms and questionnaires: (participant consent form, demographic information form, lumbar pelvic pain intensity questionnaire, and the disability rating index questionnaire).After labour, you will be asked to complete the forms at six weeks and three months as it is important to gather in-

formation before and at certain times after labour. In addition, investigators will document a physical examination in which they will assess muscular and postural changes

There are no right or wrong answers – we would just like to hear about your experience of back pain and the exercise treatment. The questionnaire should take about half an hour at the longest. Please note that some of the questions will relate to your personal history and experiences.

Do I have to participate?

No. It is up to you to decide whether or not you wish to take part. You can withdraw from the study at any time, without giving a reason. This will not affect your care or legal rights.

What are the possible benefits of taking part?

The results should help our understanding of the experience of back pain with exercise on postpartum women. As a consequence, this is expected to be beneficial to women's health care.

What will happen if I do not wish to continue with the study?

If you wish to withdraw from the study, please inform me and all the information that you have provided will immediately be destroyed.

What if there are any problems?

If you are concerned about your participation in the study and would like to discuss the matter with me, please contact me (my details below) or my academic supervisor Dr. Shuby Puthussery, Senior Lecturer in Public Health, University of Bedfordshire, on 01582743313 or via email at shuby.puthussery@beds.ac.uk.

Will the study be confidential?

Yes. All your information will be handled in confidence. Your data will be stored securely at the Department of Obstetrics and Gynaecology at the Shin Kong Medical Centre Hospital for three years before the questionnaires are destroyed.

What will happen to the results of the research study?

The data will be analysed, and anonymised excerpts may be published in health care journals and presented at professional conferences and no one will be able to identify you from these publications or presentations.

Who has reviewed the study?

This research was examined by an independent group of people, called the Research Ethics Committee to protect your safety, rights, wellbeing and dignity. This study has been given ethics approval by the Institutional Review Board (IRB) at the Shin Kong Medical Centre Hospital Research Ethics Committee. The Institute for Health Research, University of Bedfordshire has also granted ethics approval for the study.

Further information and contact details

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University of Bedfordshire Putteridge Bury
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Ms. Shuby Puthussery

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